Hearing of The

ASSEMBLY INTERIM COMMITTEE ON WATER

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Held in
Disneyland Hotel
Anaheim, ~~California~~

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ON GROUND WATER PROBLEMS (HR 179)

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[redacted]

Wednesday, November 29, 1961
9:30 O'clock, A.M.

APPEARANCES

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Committee Members Present:

Assemblyman Carley V. Porter, Chairman
Assemblyman Jack A. Beaver
Assemblyman Frank P. Belotti
Assemblyman John L. E. "Bud" Collier
Assemblyman Houston I. Flournoy
Assemblyman Myron H. Frew
Assemblyman Frank Lanterman
Assemblyman Harold K. Levering
Assemblyman Robert T. Monagan
Assemblyman Eugene G. Nisbet
Assemblyman Jack Schrade
Assemblyman Harold T. Sedgwick
Assemblyman Bruce Sumner
Assemblyman John Williamson
Assemblyman Edwin L. Z'berg

Other Legislators Present:

Senator Waverly Jack Slattery
Senator John A. Murdy, Jr.

Staff Members:

Donald W. Benedict, Senior Administrative Analyst
Ronald W. Robie, Research Consultant
Mrs. Donna K. Wells, Committee Secretary
James H. Flanagan, Jr., Legislative Intern
Joe Tracy, Sergeant-at-Arms

Legislative Counsel Bureau

Alan W. Strong

I N D E X

WEDNESDAY, NOVEMBER 29, 1961, 9:30 O'CLOCK, A. M.

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CHAIRMAN PORTER: Now, according to the advanced releases and according to our agenda, we were scheduled to start at 9:30, but with quite a bit of fog, with people having to drive and fly and being either slowed down or grounded in that procedure, we have been waiting to be certain that we had a quorum. We have a quorum either in the room or approaching the room outside, so we will start at this time.

Our meeting this morning in Anaheim is the fourth in a series of field hearings on groundwater problems which the Assembly Interim Committee on Water is holding throughout the State. Previous meetings were in Bakersfield and Fresno where we received testimony on groundwater problems of the San Joaquin Valley. We plan to hold hearings in all the more important groundwater problem areas of the State before we have completed our work in the fall of next year.

Yesterday the members of the committee were conducted on an excellent field trip through some of the more important groundwater recharge operations in the Orange and Los Angeles County areas. We had the valuable experience of seeing spreading operations in Orange County and Los Angeles County, in which we observed the Whittier narrows spreading operations including the construction of the sewage reclamation plant, and the injection wells to repel sea water intrusion in the west coastal area. These operations are probably the most advanced activities of their type in the world.

Today we are to receive testimony from the agencies that operate the works we visited yesterday. These agencies also conduct many other valuable groundwater operations. The testimony will be presented by members of a local informal committee who have been working on plans for this hearing since early summer. After we have heard from the Department of Water Resources, I should like to ask Mr. Warren Butler to introduce those members of the local committee who worked on this hearing. Then Mr. Butler will introduce those people who are to testify today.

In scheduling the present series of hearings, the Assembly Interim Committee on Water is seeking to secure a broad and comprehensive knowledge of the problems related to groundwater recharge or replenishment, giving particular attention to the management or operation of groundwater basins. After we have received factual testimony throughout the State we shall analyze it to determine what legislation is necessary. Only after we have analyzed all of the testimony from our field hearings, such as this one today, will we be ready to consider the important bills relating to groundwater programs and policies which have been referred to this Committee for interim study. When we take up these bills for interim study next year, we hope that those of you in the audience will be ready with good suggestions to assist us.

Since our meeting today will include testimony from only the coastal sections of Orange and Los Angeles Counties, it seems appropriate that I should announce we still plan to hold a hearing in the Ventura area and another hearing to cover the eastern part of Southern California. These two hearings will be scheduled for next

spring. I might also remind you that our Subcommittee on Saline Water and Atomic Energy, Assemblyman Jack Beaver, Chairman, will meet in Sacramento on December 12, 1961. On December 13, 1961 the full Committee will meet in Sacramento for a further hearing on the Sacramento-San Joaquin Delta.

We are pleased today to have sitting with the Assembly Water Committee Senator Jack Slattery from the Senate Water Committee over at my right sitting with Mr. Sedgwick and Mr. Monagan. You are welcome, of course, to ask questions at any time. One of the things we miss is the old joint water committee between the two houses which formed such a desirable forum for an interchange of thinking between the two houses. So some of us from the Assembly Water Committee and from the Senate Water Committee try to sit with each other when it is possible. And we also, of course, are pleased to have at my extreme left nearest to you, State Controller Alan Cranston. Would you stand up and take a bow, Alan. We all feel more certain that our vouchers will be paid for our attendance here today because the boss saw us at work.

Now, let me introduce the members of the committee. Coming this way is one of your own Assemblymen from Orange County, Assemblyman Bruce Sumner. Next in order coming this way is Assemblyman Eugene Nisbet from Upland , representing a goodly portion of San Bernardino County which I am always reminded takes up and occupies one eighth of the area of the State of California. Most of it is impossible to climb over. He is a member of our powerful Rules Committee which acts on the budget of this committee, so he knows I'm just joking when I said that last. The other part

of San Bernardino County is represented by another member of the water committee, Assemblyman Jack Beaver from Redlands. He is also doing an outstanding job on the Saline Conversion Subcommittee, and next is is the man who has such a difficult time flying from that area in the far northern part of California which has been said to be the foggiest part of the world. It lost its title I think yesterday. Frank Belotti, Assemblyman from Eureka.

ASSEMBLYMAN BELOTTI: You are doing well by way of competition.

CHAIRMAN PORTER: We grow everything real big down here except redwood trees. From Kings and Tulare County next is Assemblyman Myron Frew. Coming around the corner of the committee table is Assemblyman Frank Lanterman from La Canada in Los Angeles County. And coming this direction is another member of the Rules Committee, Assemblyman Jack Schrade from El Cajon and San Diego County, a long-time member of the water committee and I suppose the longest and oldest member in terms of seniority on the water committee. Next is Assemblyman Harold K. Levering, of Santa Monica, Los Angeles County. Over at the far right of the committee table from Stockton in San Joaquin County, Assemblyman Bob Monagan, and I have already introduced Senator Slattery from Lake County. Next is Assemblyman Harold Sedgwick from Oroville. He still is an Assemblyman, although I understand he is running for the Senate. My name is Carley V. Porter. I am from Compton in Los Angeles County. In front of us, of course, is our long-time Court Reporter who has covered so many of our water hearings, Miss Alice Book, who took longer getting here last evening by plane and bus than it would have taken to drive

from Sacramento I understand. Directly in back of me is Mr. Don Benedict who furnishes the consulting service for our water committee, Mr. Benedict being from the Legislative Analyst's Office. To the left in back, of course, is Mr. James Flanagan the Legislative Intern working with the water committee this year, and in the back row at my right, our excellent Research Consultant, Ron Robie, without whom we could hardly do in the office and throughout the State.

Our first witness is Mr. Herbert A. Howlett, the District Engineer of the Southern District of the Department of Water Resources. He was scheduled to fly in last evening and was grounded and drove all night to get here. I think he deserves honorary mention and his statement will be looked upon in a kindly fashion by the more truculent members of the committee. Mr. Howlett.

MR. HOWLETT: Thank you very much, Mr. Porter for those kind thoughts. I am Herbert A. Howlett, District Engineer of the State Department of Water Resources and I am making this statement today on behalf of William E. Warne, Director of Water Resources. I will be assisted by Mr. Lloyd C. Fowler, Chief of the Southern District Planning Branch who accompanied you on the tour yesterday. Mr. Fowler is sitting here on my left.

Now, this statement is made pursuant to a letter dated October 25, 1961, from your chairman, in which he requested specific information on groundwater basins in Los Angeles and Orange Counties.

CHAIRMAN PORTER: I see approaching Senator John A. Murdy, long-time water leader in the State Senate. We certainly welcome you to sit with the committee today and we are delighted to be

meeting in Orange County.

SENATOR MURDY: Thank you, Carley.

CHAIRMAN PORTER: It also occurs to me I forgot to introduce the most important member of the water committee, Mrs. Wells, at my right. She does all the work here and I guess we tend to overlook the most faithful member. Now, approaching the committee table is Assemblyman Ed Z'Berg from Sacramento County and next to him coming this way is Assemblyman John C. Williamson from Kern County. Any minute Assemblyman John L. E. (Bud) Collier of Eagle Rock will approach and be seated. I think he is at the telephone. Now, excuse the interruption and you proceed, Mr. Howlett.

MR. HOWLETT: Mr. Chairman and Members of the Committee, this statement is made pursuant to a letter dated October 25, 1961, from your chairman, in which he requested specific information on groundwater basins in Los Angeles and Orange Counties. Accordingly, our statement today is limited largely to the matters pertaining to groundwater in these counties. Following a brief introduction, this presentation is organized to provide answers to the three questions asked in your letter.

The economic development of the Southern California area to the level now existing has, in large measure, been a result of the availability and utilization of its underground water resources.

On the map, and I would point out the code on it, the yellow reflects groundwater basins in the southern portion of the State.

The darker areas are the non-water bearing areas.

Prior to the exploitation of groundwater, the limited

magnitude and erratic occurrence of rainfall and runoff was an inhibiting factor even in such enterprises as cattle raising. Today, Southern California has a population in excess of 8,000,000 with a dynamic industrial, and commercial activity and an assessed valuation of over one-half that of the entire State. It has several hundred thousand acres under irrigation, devoted to the production of high-value crops.

As the economic development of the area increased, the utilization of groundwater also increased. Soon, use exceeded supply and over-draft conditions developed in most Southern California groundwater basins. However, it was this overdevelopment of groundwater that enabled Southern California to develop an economy capable of financing the later necessary importation of additional water supplies.

The area under discussion, the coastal portions of Los Angeles County and Orange County, covers a total of about 1,460,000 acres, of which about 675,000 acres are mountains and foothills, and 785,000 acres are valley lands. About 50 percent of the total area consists of groundwater-bearing alluvial valleys. The groundwater basins (shown on the display chart) consist of the San Fernando Basin; the basins underlying the coastal plains of Los Angeles and Orange Counties, better known as the Santa Monica, West Coast, Hollywood, and Central Basins in Los Angeles County, and the Anaheim, Santiago, Yorba Linda, and La Habra Basins in Orange County; and the San Gabriel Valley Basins, which include the Raymond and Main San Gabriel Basins.

There is a vast amount of storage capacity in these basins,

a great portion of which has been utilized. It is estimated that three and one-third million acre-feet of underground storage have been dewatered at one time or another in basins in Orange County and Los Angeles County.

In these overdrawn basins there exists more storage capacity, within considered economic pumping depths, than is required to regulate the natural water supply available thereto. This excess capacity is being, and in the future, should be increasingly utilized in certain areas for the regulation and distribution of imported water. The use of underground storage for this purpose will become increasingly important in the future, with a greater portion of the areas's water requirements being satisfied by imported water.

Now, turning to your specific questions.

QUESTION 1: (Furnish) a general discussion of the ground water supply and groundwater problems within the area under discussion (i.e.: Los Angeles and Orange Counties) along with some indication how they receive their groundwater supplies (by surface or underground means) from adjacent areas.

Groundwater Supply and Groundwater Problems are taken up consecutively below.

Groundwater Supply

To the extent that Los Angeles and Orange Counties are integral portions of the Southern California metropolitan complex, a discussion of their water supply must take into consideration the water supply of this area as a whole.

The groundwater basins underlying those portions of the Los Angeles and Orange Counties draining into the Pacific Ocean are part of the South Coastal Complex of groundwater basins. This complex is among the largest and most productive groundwater basins in

the State. Water-bearing sediments, interlaced with relatively impermeable clays and partially separated by rock outcrops, faults, etc., extend from the mountains out under the Pacific Ocean and to depths well below sea level. In the coastal plain areas of Los Angeles and Orange Counties, these deposits contain fresh water to depths of as much as 3,500 feet below sea level.

The following table compares that portion of the storage capacity contained within historic high and low groundwater levels with total usable capacity in the coastal groundwater basins of Los Angeles and Orange Counties. (See Page 11a)

I'll only summarize and generalize the table which you have before you. It points out that in Los Angeles County there is a total estimated usable storage capacity of about 4,000,000 acre-feet with a historically utilized capacity of about two and a half million acre-feet. Within these totals are some interesting comparisons that I draw to your attention. In Orange County the total usable is 462,000 acre-feet with a historically utilized 885,000 and again there are some interesting comparisons to be made.

The groundwater storage capacity of these deposits, measured between high water levels and the base of fresh water-bearing materials, is actually many times the estimated usable capacities shown on the table. Usable capacity is limited by one or more critical conditions, the most prevalent of which are sea water intrusion and water quality degradation, both associated with declining groundwater levels. On the above table the limiting condition is sea level in the coastal basins and 200 feet below the ground surface in the inland basins.

Basin Name	Storage Capacity (acre-feet) Estimated Usable	Historically Utilized
LOS ANGELES COUNTY		
San Fernando Valley	900,000	600,000
San Gabriel Valley	1,500,000	710,000
Coastal Plain		
Central Basin	1,340,000	780,000
Hollywood Basin	80,000	30,000
Santa Monica Basin	36,000	38,000
West Coast Basin	120,000	300,000
Total	3,976,000	2,458,000
ORANGE COUNTY		
Anaheim Basin	390,000	860,000
Santiago Basin (included with Anaheim Basin)		
Yorba Linda Basin	26,000	13,000
Santa Ana Narrows Basin	10,000	
La Habra Basin	36,000	12,000
Total	462,000	885,000

(Note: Excess of historically utilized capacity over estimated usable capacity constitutes overdraft from elevations below sea level.)

Until very recently, groundwater resources met more than half of Southern California's water demands. In 1930 about 70 percent of the water used in the area came from the underground, in 1950 about 63 percent, and in 1958 about 55 percent. It is only since employment of the Colorado River Aqueduct in 1960 to its full intake capacity of up to 1,212,000 acre-feet annually (with an estimated actual delivery potential of 1,180,000 acre-feet) that the groundwater contribution to local supply dropped to approximately 50 percent or less.

Total groundwater use in Southern California equals about 1,250,000 acre-feet per year, including an annual overdraft of about 400,000 acre-feet. Present imports to the area amount to about 1,360,000 acre-feet of water annually; 340,000 acre-feet (the Los Angeles Aqueduct's full capacity) delivered to consumers in Los Angeles, and 1,022,000 acre-feet of Colorado River water (1960-61 fiscal year).

Of Colorado River water imported to coastal Southern California in the last fiscal year, 515,000 acre-feet was put directly to domestic and industrial use, 100,000 acre-feet was used in agriculture, 70,000 acre-feet went for increased storage in Lake Mathews and 337,000 acre-feet was percolated to groundwater basins in Orange and Los Angeles Counties (Colorado River water was used directly for groundwater recharge only in these counties last year).

The Orange County Water District has been spreading Colorado River water in the Santa Ana Narrows and Anaheim Basins since 1949 and over the intervening years has spread upward of 800,000 acre-feet.

Since 1954, the Los Angeles County Flood Control District

has spread about 530,000 acre-feet of Colorado River water for groundwater replenishment in the Central and West Coast Basins of that county.

The Metropolitan Water District of Southern California reports that up to the present time it has delivered 1,360,000 acre-feet of water for groundwater replenishment in Los Angeles and Orange Counties. This was approximately 25 percent of the total water delivered by the district from 1949 to the present time.

In Southern California's coastal counties, from Ventura to San Diego Counties, surface water captured and made available from surface reservoirs could amount to about 150,000 acre-feet during a normal weather cycle. Inasmuch as most of the area's reservoirs are situated outside Los Angeles or Orange Counties, and because this area has been caught up in a cycle of generally subnormal rainfall for the last 17 years, the contribution to local supply from surface water storage reservoirs in the two counties is negligible.

Groundwater Problems

The safe yield of groundwater in Los Angeles and Orange Counties is estimated to be about 500,000 acre-feet annually, and the annual overdraft of these basins is about 200,000 acre-feet, notwithstanding replenishment operations.

The basic groundwater problem in these counties is overdraft (i.e.: the use of groundwater at a rate which exceeds the average annual recharge, resulting in falling groundwater levels), which is accompanied by the following related phenomena:

Sea Water Intrusion. Groundwater pressure levels in many coastal areas are from 30 to 100 feet below sea level. Wherever

these aquifers abut on the ocean, sea water can penetrate inland. In Los Angeles, Orange, and Ventura Counties, more than 22,000 acres are underlain by saline-degraded groundwaters and the intrusion area is steadily expanding.

Water Quality Degradation. As groundwater levels are depressed, we find localized areas where quality deterioration seems to be related to water levels. In a few of these areas there is evidence that connate waters in sediments surrounding and underlying these groundwater basins are infiltrating into the basins when water levels receded. These connate waters are usually highly saline and they can seriously impair the water quality of the basin affected.

Adverse Salt Balance. When the consumptive use of water in a valley or basin is increased there is a tendency for the salt content of the water therein to increase in concentration. If outflow of water from a groundwater basin is reduced, the outflow of salts will generally be reduced, so that there will be a further tendency toward an adverse salt balance.

Excess irrigation water applied to irrigated crops to minimize salt concentrations in the root zone of the crop frequently seeps underground to the groundwater basin. Such water gradually depreciates the quality of the groundwater body. Even though large areas of Southern California have been converted from agricultural to urban usage, the home owner applies approximately half of his purchased water to lawns, trees, and shrubs, and significant quantities of irrigation return water can still reach and slowly deteriorate the quality of groundwater.

Other groundwater problems in Los Angeles and Orange

Counties, not necessarily directly related to overdraft conditions are the following:

Penetration by Industrial and Domestic Wastes. Industrial waste discharges frequently contain deleterious materials which are harmful even when present in minute quantities. Other wastes may contain exotic organic compounds which are capable of producing objectionable tastes and odors in drinking water when only a few parts per billion are present. Synthetic detergents present in industrial waste discharges cause serious nuisance problems.

Although a large proportion of the waste water from major Southern California metropolitan areas is discharged to the ocean, significant quantities of waste water are discharged to land. These land disposals, when added to the seepage from thousands of individual cesspools and leach lines, constitute an appreciable source of groundwater recharge.

Studies indicate that dissolved salts added to water during domestic use increases the mineralization by as much as 300 parts per million. This mineral increment averages 70 pounds per capita per year, or about 35,000 tons of salt per year per million people.

Synthetic detergents in domestic sewage are resistant to treatment and are of growing concern as potential contributors to taste and odor problems.

Pollution by Disposal of Refuse and Decomposable Matter. In Southern California most refuse and rubbish is disposed of in cut and cover fills rather than in the ocean or by burning. This is particularly true in metropolitan Los Angeles where burning has been stopped as a smog control measure and the volume of refuse and rubbish collected for ultimate burial in fills has more than doubled.

These huge rubbish fills have become a source of concern, since decomposing garbage and refuse generates gases which may dissolve in the groundwater. In addition, rainfall or applied water may percolate through the refuse, leaching out deleterious minerals and salts and carry them to the groundwater.

Even if there were no possibility of groundwater rising high enough to inundate these dumps and thereby become polluted, the groundwaters may still be polluted by downward passage of leachate and by diffusion of gases of decomposition. This situation can be aggravated by percolation of irrigation water where a park or golf course is the final use of such landfill operation.

Unfortunately, many of these landfill operations are placing decomposable refuse in the empty storage space of the groundwater reservoirs, thereby usurping the use of a much greater volume of groundwater storage capacity. This storage capacity should be protected just as vigilantly against pollution as the groundwater quality. Without the free use of much of the storage capacity in our groundwater reservoirs we cannot practice proper groundwater basin management needed to fully conserve the runoff within the State.

An aggravation to groundwater problems, of whatever origin, is:

Diminution of Natural Recharge to Groundwater Basins Resulting from Urbanization.

Under natural conditions, runoff from the mountains percolated to and recharged the groundwater basins through the permeable deposits in and underlying the streams which meandered across the plain. However, urbanization has forced construction of lined flood control channels, and even though spreading basins have been built

to spread flood runoff, they probably cannot fully restore the deep percolation which occurred under natural conditions. In years of heavy precipitation, the deep penetration of rainfall was an additional source of recharge to groundwater basins. The building of roads, homes, and large paved areas, has greatly reduced the proportion of water from this source which formerly penetrated to groundwater basins. Water from such rainfall was virtually free from dissolved minerals and constituted an important source of excellent quality recharge.

QUESTION 2: (Furnish) a schedule and description of the department's program of groundwater basin studies now under way in Southern California.

The statement presented to this committee in Sacramento on August 29, 1961, listed a number of statewide studies carried on by this department, several of them being of a continuous nature and encompassing Southern California. In the area of groundwater, the department conducts the following programs from its Southern District office in Los Angeles:

Now, Mr. Chairman, I'll simply mention the titles of these at this moment. If there are questions on them, I'll fill in later. We have our groundwater measurement program, our water quality sampling and monitoring program, special water quality investigations for water pollution control boards and assistance to such boards, sea water intrusion investigations, development of standards for water well construction and then we have some investigations that are a little broader in scope and they are the Coachella Valley Investigation, which is a cooperative groundwater study with the Coachella Valley County Water District and we have a planned

Utilization of Groundwater Basins study which we will discuss a little more later in this paper. Now, the Groundwater Basin Protection Projects is the name applied to the program authorized by the Porter-Dolwig Groundwater Basin Protection Law passed by the 1961 Legislature. In accordance with the intent of the legislation, this program provides for the formulation of detailed plans for projects that will correct or provide protection against irreparable damage to, or impaired use of, groundwater basins caused by water quality degradation. As this is a newly authorized program I would like to explain it in some detail.

Under the Porter-Dolwig Act we are giving consideration to three programs of study in the South Coastal area during the current fiscal year:

1. Evaluation of sea-water intrusion and the formulation of corrective projects in coastal groundwater basins.
2. Study of effects on groundwater quality of the disposal of decomposable waste in gravel pits and the formulation of plans to prevent water quality degradation by existing dumps.
3. Plans for projects to alleviate salt balance problems in the groundwater basins along the Santa Clara River in Ventura County.

With the exception of the Alamitos Gap, we have been evaluating the sea-water intrusion problem in the coastal areas on a reconnaissance basis under our continuing program of sea-water intrusion investigation. The Alamitos Gap has been intensively studied by the Los Angeles County Flood Control District, under its excellent

sea-water barrier investigation. As a result of our reconnaissance studies, we have been able to delineate the areas of intrusion and approximate subsurface geologic configurations.

However, in order to formulate a project against further water-quality degradation, it will be necessary to supplement available information on subsurface geology by exploratory drilling, and to evaluate the hydraulic characteristics of those basins by the construction and study of both pumping and recharge wells. It will also be necessary to study and evaluate the subsurface geology in the adjacent mesa area which separates one gap from another.

With regard to corrective projects to prevent further sea-water intrusion, we are presently considering the area along the coast from the Santa Ana Gap to the Alamitos Gap to determine the sequence and schedule of specific studies. We are following the negotiating of the Los Angeles County Flood Control District and the Orange County Water District with regard to design of a project for the Alamitos Gap which borders both counties.

The refuse disposal study will be conducted in cooperation with Engineering Science, Inc., a local firm under contract with the State Water Pollution Control Board to develop data on the diffusion of gases of decomposition through alluvial materials. Our department will investigate the effect of these gases and leachate from the dumps on the quality of underlying groundwaters. We will also attempt to determine the effects upon groundwater quality of irrigation of parks planted on the soil covering the completed disposal sites. During the current year, we will select a suitable site in cooperation with the Los Angeles Regional Water Pollution Control Board

and Engineering Science, Inc., obtain necessary rights of way and permits, install test wells and instruments and recorders, and collect and analyze groundwater samples.

In the groundwater basins along the Santa Clara River in Ventura County, the heavy extractions and re-use of groundwater, combined with the basically poor quality of recharge water, have created doubt that these basins can continue to be used without remedial action. The objectives of this investigation would be to formulate and compare alternative plans to alleviate the salt balance problem.

These programs are considered as requiring study over a number of years and have been scheduled accordingly. If necessary funds are made available during 1962-63, studies initiated during the current year will be continued. The studies of sea-water intrusion along the Orange County coast would be extended in accordance with the schedule which is presently under determination and the design of protective projects would be initiated.

QUESTION 3: (Furnish) a discussion of the policies, assumptions and methods of analysis employed by the Department in conducting the above groundwater studies and arriving at conclusions regarding the operation and management of groundwater basins.

As established by the legislature, it is the general policy that the water resources of the State be put to beneficial use to the fullest extent of which they are capable, that the waste or unreasonable use or unreasonable method of use of water be prevented, and that the conservation of such water is to be exercised with a view to the reasonable and beneficial use thereof in the

interest of the people and for the public welfare. We in the department apply the policy equally to surface and groundwaters.

Because of this interest of the people in the use of the water of the State, it has been established policy that the State shall determine what water of the State, surface and underground, can be converted to public use or controlled for public protection. In addition, the public interest in the development of the water resources of the State is of vital concern to the people of the State and, therefore, it has been established policy that the State shall determine in what way the water of the State, both surface and underground, should be developed for the greatest public benefit.

The department recognizes underground water and groundwater basins as natural resources equivalent in importance to surface water. Without the full and careful use of this vital natural resource, it is certain that the objectives of the California Water Plan--the full satisfaction of water requirements in all parts of the State for all beneficial uses and purposes--can never be achieved.

The department also recognizes underground storage, though now empty of groundwater, as a natural resource that must be preserved for the use of the present and future generations. This storage capacity is essential to optimum utilization of the groundwater basin in storing and distributing local and imported water supplies.

In order to achieve full conservation of the State water resources and to provide for the ultimate water requirement it is necessary that ground water basins be properly managed.

As a partial answer to the latter portion of your question I would like to describe our present groundwater basin management

studies. It is not possible to provide the detail you perhaps desired because of the complex technical nature of this problem. In addition, the methods of analysis of basin management concepts, as well as the concepts themselves, are still in the formulative stages.

The necessity of importing water to keep pace with the continued growth of Southern California is recognized. The construction of the State Water Facilities, due to reach Southern California by 1970-72, will provide the area with the additional water it needs, until approximately the year 1990.

However, upon arrival at terminal reservoirs, the water must be conveyed to centers of use; be regulated to meet the peak demands; and be distributed to the ultimate users. Conventional practice would call for the strategic placement of surface reservoirs, to provide the necessary regulation. A serious problem arises however, since sites for such reservoirs in Southern California are inadequate to permit retention of the volume of water required, and their locations do not lend themselves to minimizing distribution costs. By contrast, Southern California's groundwater basins are available, have the storage capacity needed to meet peak (seasonal, monthly, and daily) requirements, and are generally situated close to the centers of use.

Additional surface distribution lines will doubtless be required to supplement the existing network. Yet full advantage should continue to be taken of the fact that groundwater basins serve also as natural distribution facilities. It would be very costly, as well as unnecessary, to substitute surface distribution systems

entirely for the presently used groundwater basins in Southern California. Through planned operation of these basins, their utility as both storage and transmission vessels can be exploited in supplementing, and reducing the need for, surface distribution systems.

In view of the anticipated need for management and operation of Southern California's groundwater basins, in conjunction with water imports, the department commenced studies in this direction in the summer of 1959, funded by a legislative appropriation of that year. Under this program we will delineate the boundaries and the geology of the groundwater basin; determine the hydrologic characteristics of the basin, including a re-evaluation of the overdraft and the groundwater storage available for replenishment with imported water; determine the best methods for utilization of the basin that would achieve fullest conservation of local supplies and also provide for seasonal and cyclic regulation of imported water supplies; make an economic comparison of alternative plans of operation and set forth the legal problems that may be involved in each plan; and recommend an optimum program for the operation of each of the groundwater basins.

We have divided the investigation of each major groundwater basin into three phases: (1) geology, (2) hydrology, and (3) operation and management.

The geologic phase of the investigation determines the extent of the forebay or free water table area, the storage capacity and transmissibility of the equifer or aquifers, the depth and aerial extent of the various aquifers and their points of interconnection, and the occurrence or special geologic features, such as

faults and folds, which may affect the occurrence and movement of groundwater.

The hydrologic phase encompasses studies of surface and groundwater hydrology, including the quality of surface and groundwaters. Detailed data on items related to the hydrologic equation are compiled and analyzed to determine the historical annual surpluses or deficiencies of water; the safe yield and overdraft, if any, of the groundwater basin. In addition, this information is used to study the effects on the water level elevations under future conditions of replenishment and extraction in order to select the best plan of operating the groundwater basin. Incidental to these studies and based on the geologic studies is a determination of the ability of the sediments in the recharge areas to permit the infiltration of water into the aquifers and of the ability of the aquifers to store water and to transmit water to the various areas of use throughout the basin.

The third phase of the investigation is a study of the coordinated operation of the groundwater basin that will allow its maximum utilization for the storage and distribution of local and imported water supplies. Plans for pumping are developed for the maximum utilization of the groundwater basin storage while still permitting the aquifer to transmit required amounts of water throughout the basin. These plans consider water quality aspects, especially the maintenance of the proper salt balance in the basin. In the coastal areas it may be necessary to plan for the utilization of groundwater recharge ridges or other means to prevent or halt seawater intrusion. From studies of recharge and use of the storage

capacity in the forebay or free groundwater areas, operational procedures are developed to prevent water levels from rising to the point where waterlogging will cause property damage.

Plans for the surface distribution of water in those areas where the groundwater basin is found incapable of transmitting the required amount of water to the place of use are to be formulated. In the operational phase, both electronic analog and digital computers are put to use to outline and compare alternative plans of basin operation.

In connection with the third phase of work, concurrent economic feasibility analyses are conducted. These will develop the unit costs of water as a basis of comparison between alternative schemes. Another economic aspect which is considered involves the mineral quality of the supply as it affects treatment costs for municipal and industrial purposes.

An interim report for each of the three phases will be prepared to summarize the information developed from the particular area of investigation and a final comprehensive report detailing the results of all three phases of the investigation of each major groundwater basin will be prepared. A summary of the geology, hydrology, and possible plans of operation, and a detailed presentation of the mose economical plan of operation will be included in the final report.

The first area to be investigated under this program contains the groundwater basins of the Coastal Plain of Los Angeles County.

Studies of the San Gabriel Valley groundwater basin were

initiated in January 1961. The geology studies will be completed during this fiscal year and the hydrology phase will be completed by December 1962. The operational studies of this area will commence in fiscal year 1962-63.

In January 1962 the geologic studies of Chino Basin will be initiated. Local agencies have been greatly concerned by the critical water supply situation in parts of Chino Basin and the urgent need for imported water in this basin. Accordingly, the 1961 State Legislature passed Assembly Concurrent Resolution No. 65, requesting the Department of Water Resources to undertake (as rapidly as possible) the study of Chino Basin. The final report describing the economic plan of operation for this basin is scheduled for completion in 1964.

Also, during 1962-63, the comprehensive geologic studies of the groundwater basins in the Coastal Plain of Orange County will be initiated. This area is as geologically complex as the Coastal Plain of Los Angeles County, and will require considerable effort to properly delineate the aquifers and the geologic structures affecting groundwater occurrence and movement. However, because of the experience gained in the study of the Los Angeles Coastal Plain, this investigation should not take as long. The operational phase is scheduled for completion in 1965.

Mr. Chairman, Mr. Fowler is very very familiar with groundwater basins here in Southern California and between the two of us I believe we can answer most of your questions.

CHAIRMAN PORTER: Thank you very much, Mr. Howlett for that excellent statement and may I observe that it was particularly

well presented for a man who had to drive all night and whose eyes must be sticking out almost to touching his glasses. Before I call on the other members of the committee, I have one question. It is not technical in nature, I don't believe. I think it is at the top of page 5 where in the top five or six lines you speak about the quantity of water which has been brought in and finally brought in in sufficient quantities to reduce the use of groundwater to approximately 50 percent. My question is just for information, is there any place else in the world where this quantity of water referred to is brought such a great distance to meet local needs?

MR. HOWLETT: I'm not aware of any other place nor am I aware of any other place in the world that brings water for such long distances and then percolates it into the underground basins.

CHAIRMAN PORTER: Thank you very much.

ASSEMBLYMAN LANTERMAN: Question, Mr. Chairman.

CHAIRMAN PORTER: Mr. Lanterman.

ASSEMBLYMAN LANTERMAN: On page 9 in reference to, I believe it is the percent of flood flow lost as a result of lined channels, you didn't indicate a percentage of loss particularly for Los Angeles County. I wondered if you were aware of the amount of loss as an estimated flow?

MR. HOWLETT: Do you have an approximation on that, Lloyd?

MR. FOWLER: Of what?

MR. HOWLETT: Of the percentage of the flood flows that are lost in relation to the annual runoff of the streams?

MR. FOWLER: Well, in the past it has been less than 10 percent. It has been averaging around 6 percent for all of Southern

California. This is the outflow to the ocean generally. That is a result of runoff from the urban areas, very close to the areas where conservation facilities are just not possible so if it were possible we would probably save that last 8 or 9 percent also.

ASSEMBLYMAN LANTERMAN: Well, the way the paper is presented, it didn't indicate the achievement that has been reached in water settling and percolation particularly in these two counties and I thought perhaps it might have been well to have included this in the paper by direct reference. That is the reason I raised the question, because the implication is that because of lined channels there is considerable loss in flood flow and I wanted to point out very clearly that we have done in these two counties a remarkable job of curtailing these storm losses.

MR. HOWLETT: We would agree with that and if you would like, Mr. Chairman, we would be glad to get the precise percentage and supply it to your committee.

CHAIRMAN PORTER: Yes, if you would do that, and now, Mr. Lanterman, you will notice, has referred to Southern California, so if you would do it to show the 92 percent which I recall it is in Los Angeles County of water which is saved; in other words, we only lose I believe 8 percent of the water which falls in Los Angeles County and then the same figure for possibly Orange County separately, and then to directly answer Mr. Lanterman's question for Southern California - if we might have it in that fashion, in three parts.

ASSEMBLYMAN SCHRADE: Mr. Chairman, will you also include San Diego in those figures?

MR. HOWLETT: We can make an attempt to do that. If we

have the information, we will do that.

ASSEMBLYMAN LANTERMAN: And the second question, there is no comparison made as to the average overdraft for various reasons in other central counties, and I wondered if it should not be as a matter of comparison available to us simply as an added footnote to make a comparative loss of underground water basins storage by overdraft, simply by comparison between Southern California and other counties.

MR. HOWLETT: In the department we can also do that and will present it to your committee.

ASSEMBLYMAN LANTERMAN: Thank you.

CHAIRMAN PORTER: First Mr. Belotti and then Mr. Beaver.

ASSEMBLYMAN BELOTTI: I didn't have any questions.

CHAIRMAN PORTER: Mr. Beaver.

ASSEMBLYMAN BEAVER: Once again, getting back to the subject of recharging the underground basins by the use of Colorado River water, we observed yesterday that in the Santa Ana Basin raw Colorado River water, untreated, was being put into an area known as I believe the Santa Ana Narrows Basin. This water, I say again, this is raw untreated water coming via the aqueduct from Parker Dam. Now, if we continue to use this water up to the amounts that they are presently using to recharge these underground basins, and if at the same time this water remains untreated and the rate of the degradation of the quality of the Colorado River water continues, how fast will we accelerate the total pollution of these respective basins with respect to salt content by this continued use of this quality of water for recharge purposes?

MR. HOWLETT: Mr. Chairman and Mr. Beaver, if I could answer that question, we would not need some of the studies that I just described are being undertaken. We in the department have been quite concerned about the high content of the Colorado River for a number of years as I believe you are aware, and it is because of this concern and of the many unknown factors on what happens to water when it is percolated in one of these basins, how it intermixes with local supplies, the actual paths that it follows in its travel, that we have advocated the very very detailed studies, more detailed than have taken place anywhere else. I couldn't answer that question now, particularly how long it would be before we begin to get an adverse effect, if that is the final conclusion.

ASSEMBLYMAN BEAVER: Well now, there is another area that the department could study which might give you some clues in this regard and I have in mind the area of the All American Canal and this southern inland area of the State where water leaching down there has been used in agriculture for numbers of years where tile has become one of the most expensive agricultural operations in that general area or where fortunately or unfortunately, as the case may be, and I rather think it is unfortunate, that in the Salton Sea area we have a great drainage system for these leached waters bringing their salt concentrates into that general basin which seems to me to be a natural phenomena and one which is self-evident and one which is directly before us as an example of what can happen.

Now, as I say again, in the event that the water of the Colorado River continues to deteriorate in quality, it would strike me that the continued use of millions of acre-feet of water into the

underground basin in this area, were they not naturally flushed or were they not in some way treated, you would wind up with an underground Salton Sea in this whole total coastal plain. Now, I presume that the studies that have been done in Coachella Valley area will give you some clues in this regard and I trust will also give added urgency to the matter of bringing some of this Northern California water into this basin for underground recharging as well as in order in the decades ahead to prevent total pollution of a basin which cannot be flushed in the final analysis which, of course, is the situation which exists in the Coachella Valley, and I was curious to know what the department's reaction was. My question, perhaps is incapable of an engineering answer at the moment, but I think we should have in this committee some idea of how much time is left in this greatly populated area before this kind of thing will happen if it is going to happen and what measures might be taken to prevent its happening. Would you care to generalize on that subject?

MR. HOWLETT: Mr. Beaver, again I have to plead it would be presumptuous on my part to predict how much time we have until we have more answers on these problems that you cited and which I agree are problems that we must know more about. They are real problems. They are not imaginary problems. We feel that we will be getting indications about 1964 as a result of these very detailed studies of what the answers are going to be. I think that one of the nice things on the horizon is the fact that the water from the north to be imported is of excellent quality. It is by and large a better quality even than you have in your local runoff right here in the south coastal area. Therefore, to the extent that it is used by any

mechanism, deliberate percolation for temporary storage or percolation for the maintenance of an adequate salt balance, it will be a very useful tool, but again I must beg you not to ask me to prejudge the results of the studies that are very complex, and we are just getting underway.

ASSEMBLYMAN BEAVER: Now, let me ask you one further question with respect to San Diego County. In the event that you continue your studies of these underground basins, and I realize this isn't under discussion here now, but I assume from looking at the first map we have, there are some underground basins in San Diego County area.

MR. HOWLETT: Relatively small.

ASSEMBLYMAN BEAVER: They are relatively small, it is true. I have two in mind that I have seen recently and what I'm getting at is that if that general area of Southern California which is totally an import water area, in view of the fact that there are no really substantial underground basins, what is going to happen to the quality of the underground water in that area? That will be even more highly accelerated in degradation than it is here, wouldn't you assume that to be true?

MR. HOWLETT: If the overdraft condition were to prevail I would assume that that would be the condition. I would want to reiterate here that in our department we consider these underground basins all to be valuable resources, that none of them are expendable and as we have always dedicated every effort to monitoring the situation for warning the people of what the problem is, if it is worsening or whether it is maintaining a state of equilibrium, this applies in the San Diego County as well as the bigger basins we have been

talking about here. The draft on those basins down there has caused sea water intrusion problems. Percolation of waste in some cases has caused degradation problems, and the dry spell has caused reversal in direction of the groundwater movement in some cases due to the pumping.

ASSEMBLYMAN BEAVER: Is it not true that this very typical situation that we are talking about today has already passed a point of no return with respect to water quality underground in say the Ventura area, for example?

MR. HOWLETT: I'm not prepared to say it has passed the point of no return. The investigations that we are getting underway on the Porter-Dolwig Act we hope will come up with a solution to the adverse salt balance problems. It is not an encouraging thing to face, particularly when you have large areas of underground basins intruded by salt water, ocean water, but I would not say it has passed the point of no return because we have many illustrations that with the continuation of wet cycles or with the importation of water and percolation that you can get a reverse movement of that salt water front and in many cases completely overcome the problem.

ASSEMBLYMAN BEAVER: Could you tell me just as a bit of incidental intelligence what the rate of deterioration of the raw water out of the Colorado is undergoing at the present time? How rapidly is the salt content of the raw water increasing annually?

MR. HOWLETT: You would have reference to the point of diversion for the Metropolitan Water District I assume?

ASSEMBLYMAN BEAVER: At Parker Dam.

MR. FOWLER: It is improving.

ASSEMBLYMAN BEAVER: It is increasing in quality?

MR. FOWLER: Yes, sir, the total dissolved salts are becoming less in later years.

ASSEMBLYMAN BEAVER: I would like to continue that a second. Is that the result of increased watershed management ahead of the dam?

MR. FOWLER: No. The Metropolitan Water District is investigating this carefully and I can only repeat what they have told me, that the results indicated to them have been that the storage in Lake Mead has improved due to the removal of some of the salts in it. I do think this is a question that should be referred to the Metropolitan Water District.

ASSEMBLYMAN BEAVER: Thank you.

ASSEMBLYMAN LANTERMAN: Mr. Chairman, I don't want to take the time of the committee. I just simply want to ask an additional request to that which Mr. Beaver has indicated as to the quality of water of the Metropolitan Water District in its continued use for recharge, and what the difference in degradation as such is presumed to be on local basins; what the projected quality of the water and maintenance of the quality of the water of the Feather River so-called delivery system will be as population increases and whether the tributary sewage disposals of the cities in the north to that system will require management to prevent degradation of that water.

ASSEMBLYMAN BEAVER: Mr. Chairman, through you I suggest that this committee give very serious consideration as a result of its hearings to proposing a resolution along these lines to direct the department to make some studies on this time element of our total

water recharge system and the sources of the water that we are using for it and by that method perhaps they can then proceed with considerable vim and vigor in whatever direction is indicated on top of what you are already doing because I think you have in front of you basically a crash program which has to be undertaken on a much broader scale. I think if this committee would consider such a thing, I'll be quite pleased to prepare such a draft.

CHAIRMAN PORTER: I see Mr. Fowler writing that request down. Do you have it all there, Lloyd?

MR. FOWLER: I believe so, sir.

CHAIRMAN PORTER: And now Mr. Levering wanted to add something to that.

ASSEMBLYMAN LEVERING: Well, in connection with this subject that has just been under discussion I wonder - I don't know whether you can tell us now, but maybe you can tell us later, what happens? Have you made any tests so that when this raw Colorado River water with a certain amount of millions of parts of solids percolates through various kinds of soil and goes down to the underground basin, does it pick up more solids and is the end result that it gets worse from the standpoint of increasing solids in the water, or in percolating through certain areas are some of the solids removed?

MR. HOWLETT: If I may answer this question in a general term --

ASSEMBLYMAN LEVERING: Do you know that?

MR. HOWLETT: Rather than in a specific illustration. The percolation of any water through a medium does not remove any of the dissolved solids that were in that water when it was placed there.

The dissolved minerals are not taken out. The only way you take minerals out are through the sea water conversion type of processes. Even the softening process exchanges, but it does not diminish the overall dissolved solids.

ASSEMBLYMAN LEVERING: Well, it is possible then as it percolates to pick up more solids?

MR. HOWLETT: This is entirely possible.

ASSEMBLYMAN LEVERING: Okeh.

CHAIRMAN PORTER: Thank you. Any further questions? Yes, Mr. Sumner.

ASSEMBLYMAN SUMNER: Since the disposal of refuse and rubbish is the big problem in Southern California, I'm curious. You spoke of the problem that may come from water percolating through these dumps. Do you have any material so far, any results of any studies of this being a problem?

MR. HOWLETT: Mr. Sumner, this is almost a totally unexplored field at the moment. I believe here in Southern California is the first place that the ground water basins are very important and you have extremely large volumes of waste to be disposed of, so the two enter the interplay right away. There is no information on the rate of percolation and what happens to the gases and so forth.

ASSEMBLYMAN SUMNER: What type of studies are you going to conduct?

MR. HOWLETT: In this field we are going to first try to find out what happens to these gases. We have evidence that the gases generated in some of these dumps are causing adverse tastes in adjacent wells, but we are not just sure of how the gas reaches the

water, whether it is dissolved by percolating water, for example, or whether they are heavy gases that drop down to the water table and are absorbed. So the first efforts are going to be made to find out more about the gases, how much is generated, what type of gases they are and that sort of thing, and then the effect of these gases on nearby water resources. We are also going to investigate the possibility of seals perhaps on top of one of these dumps, maybe a plastic seal, for example, or a clay seal of some type. Maybe the seal could be underneath it. How are we going to do this? These things are done by putting wells through with a tube to the dumps and observing by a defined pattern what takes place. This is the beginning. We are exploring this with the Water Pollution Control Board.

CHAIRMAN PORTER: Mr. Belotti has a question.

ASSEMBLYMAN BELOTTI: I have a foolish question perhaps. Do you have any information to indicate or show that the waters, for instance the waters of the Colorado River, as compared with the waters in the Russian or the Eel, that there is a difference in the purity of those waters, the quality?

MR. HOWLETT: Mr. Belotti, in referring to this question, I would like to stick to the mineral content rather than the organic pollution of the water. Let's make the assumption that they are both about the same on the organic pollution. Yes, there are wide ranges of difference in qualities of various streams. I don't happen to be familiar with the Russian or the Eel, but as an example, the quality of the Sacramento River passing the City of Sacramento varies during flood flows from maybe 50 parts per million dissolved minerals to in the summertime when you get the highest concentration, of less

than 200 parts per million dissolved minerals. The Colorado on the other hand varies much higher. I would guess that it runs several hundred parts per million of dissolved minerals, about 600 or 700.

MR. FOWLER: About 600.

MR. HOWLETT: About 600 is an average figure for the Colorado River. These are both within acceptable drinking standards for mineral content.

ASSEMBLYMAN BELOTTI: Could that have a result affecting the ultimate price, for instance, before it is delivered say for domestic consumption?

MR. HOWLETT: Mr. Belotti, both of these cases I have cited, the first use of this water would be within drinking standards. In the first case, as the Metropolitan Water District does, they may wish to soften it, but that is not necessary to make it usable. The big problem comes in whether you might want to use it more than once. As I mentioned earlier in the paper, with every municipal use you add about 300 parts of dissolved minerals to the water. If you are starting out with water such as you have up north, you might be able to use it twice.

CHAIRMAN PORTER: Thank you very much. Mr. Nisbet.

ASSEMBLYMAN NISBET: You brought up this item of the use of dumps and that sort of thing and that is within our consideration here. The selection of a site would be of great benefit, isn't that true, rather than picking a cut and fill in the sand. If you could pick out a spot that was over heavy clay or something of that sort, perhaps along the sea coast where it wouldn't go into the basin --

MR. HOWLETT: This would, of course, help a great deal, and

I would point out that the local Water Pollution Control Boards are doing a fine job here. When one of these sites is proposed, they are obliged under the water pollution control laws to say whether this is a safe site for that particular type of thing.

ASSEMBLYMAN NISBET: Are they successful in locating those sites?

MR. HOWLETT: They don't actually have the authority to locate. They only have the authority to review after an operator has selected a site.

ASSEMBLYMAN NISBET: As you know, that is one of the most difficult problems there is. I think we are making a double problem unless we can come up with a real suggestion. Thank you, Mr. Chairman.

CHAIRMAN PORTER: Thank you very much.

ASSEMBLYMAN BEAVER: I have one more tiny question if I may. Has the department taken into consideration in the studies that you are now undertaking and those that you anticipate undertaking with respect to groundwater basins, have you made any allowances as to how much rainfall there will be and what contribution this will make in your groundwater basin? Will this be indicated in your forecast of quality?

MR. HOWLETT: Yes, very positively. Any studies of yield or of quality of a basin takes into consideration the hydrologic conditions over a long base period so this is just a natural element of the study.

ASSEMBLYMAN BEAVER: Well now, in doing this, with your constant urbanization of the area, are you going to be able to determine

the amount of rainfall percolation into these areas with asphalt jungles being created so that the water can't get down except the storm drains?

MR. HOWLETT: This is another one of the parameters that goes into a study of this type. As I say, these studies are extremely detailed. They consider the geologic structure first, how much water the underground can store, whether water can percolate from the surface or whether it has to come in from far and come in horizontally. If it comes in horizontally, what is the transmissibility rate and what is the present culture on a percolation area, what will it be at a defined development? All of these things are factors that go into one of these studies.

ASSEMBLYMAN BEAVER: So it will be in complete detail?

MR. HOWLETT: Yes, it will.

ASSEMBLYMAN BEAVER: How soon do you anticipate it will be completed?

MR. HOWLETT: Again we have the three schedules, the Los Angeles Basin, the upper San Gabriel and Chino, following in that order.

ASSEMBLYMAN BEAVER: 1964?

MR. HOWLETT: About 1964 we should have all of these real advanced.

ASSEMBLYMAN BEAVER: And in the meantime between now and 1964, which is three years, two and a half to three, you see nothing from an engineering or water quality standpoint that would impair this particular basin here with the use of additional hundreds of thousands of acre-feet of raw water from the Colorado during the

interim?

MR. HOWLETT: During this period I would strongly urge the percolation of all the water into the groundwater basins you can to prevent the invasion of sea water.

ASSEMBLYMAN BEAVER: I haven't heard it mentioned. What percentage of the water goes into the percolation of underground, if any?

MR. FOWLER: My understanding at the present time is none.

ASSEMBLYMAN BEAVER: Is there no percolation effect there from the Owens River at the outfall of the San Fernando?

MR. FOWLER: The percolation from the reservoirs in that area is probably very small and these figures would have to come from the City of Los Angeles Department of Water and Power.

ASSEMBLYMAN BEAVER: What is the salt content of that Owens River water now?

MR. FOWLER: It is about 150 parts per million.

ASSEMBLYMAN BEAVER: About 25 percent of that of the Colorado River on an average, is that a fair statement?

MR. HOWLETT: Yes.

CHAIRMAN PORTER: May I ask, is there anyone here from Los Angeles city who can answer Mr. Beaver's question about the percolation of Owens Valley water?

MR. WILFONG: We can only give you an approximate answer because of the various conditions that exist from year to year, but a very rough answer would be approximately 25 percent of the water that is imported and used within the San Fernando Valley would recharge the underground waters.

ASSEMBLYMAN BEAVER: With 125 parts per million salts, right?

MR. WILFONG: Yes, sir.

ASSEMBLYMAN BEAVER: Is that your current average?

MR. WILFONG: That is approximately right.

ASSEMBLYMAN BEAVER: About how long has that quality of water been existent through your system? Has that been a constant figure?

MR. WILFONG: It is improving.

ASSEMBLYMAN BEAVER: Thank you very much. That's all.

CHAIRMAN PORTER: Thank you very much, Mr. Howlett. Now, let me at this time introduce Mr. Warren Butler, Vice Chairman of the Metropolitan Water District, and he in turn will put on the witnesses on the balance of the agenda. I might say parenthetically that I have met three times with this informal planning group in Southern California referred to in my opening statement. Mr. Don Benedict and I met with them once, and they have put a great deal of work into the planning of today's material. I presume in order to avoid needless repetition and in order to give us a most comprehensive and well-balanced presentation, and lest I intrude upon what Mr. Butler is about to say, let me ask Mr. Warren Butler to present his witnesses.

MR. BUTLER: Thank you, Mr. Chairman. Let me say this to save the committee's time. All of the speakers today, including Mr. Howlett, are members of the committee. Others who have participated and have been very useful include, and I would ask those that are present to stand as I identify them, Mr. William Farquhar, long-time leader in the West Coast Basin Water Association, president of the

West Basin Municipal Water Basin District, also a member of the Metropolitan Board; Mr. Fowler whom you met here has also been very helpful; Mr. John Teerink whom I don't think is here, but who is assistant chief engineer of the Department of Water Resources, has also given us a great deal of his time and assistance; also Jack Curran of the Department of Water and Power of the City of Los Angeles; Mr. Max Socha, manager of the Department of Water and Power of the City of Los Angeles. Mr. Max Socha, manager of the Department of Water and Power of the City of Los Angeles, who by the way will replace Mr. Sam Nelson, the chief engineer and general manager, is the speaker on this program. Mr. Arthur Bruington , who is head of the water conservation activities of the Los Angeles County Flood Control District.

We who live on the south side of Los Angeles County and in virtually all of Orange County find it most welcome that the water committee of the State Assembly, lead by its able chairman, are visiting us these two days in the course of their inquiry into California's underground water problems. And, representing a committee that has been intensively preparing for this day since last July, we want to say you are most welcome.

Almost everyone interested in water has been talking about the underground water problem in recent months. We have in this area not only been talking about it but we have been intensively doing something about it -- at least as far back as 17 years. We would, however, be the last to boast that we know all the answers or that we have solved all the problems. But we think we have had some important accomplishments and that we're on our way to basin

management as we and California need underground basin management.

Yesterday a tour was taken to give committee members an opportunity to view for themselves what is physically being done in this program. Today we want to amplify this with further information to provide for you a more complete picture, using people we feel most competent to discuss what is being done and what is being planned ahead.

Those of us connected with the Metropolitan Water District of Southern California, I think, would like to point out in passing that our district has been taking an avid interest in what has been going on from its inception. We have tried to help and facilitate in every way possible, consistent with the interests of all of our people. It was proper that we should do so as in the Colorado River Aqueduct we had the essential supplementary water supply and we early recognized that the aqueduct to run properly must somehow, working with local interests, utilize this terminal storage that underground basins which had been overdrawn made available.

In the same way the State too must inevitably have a cooperative interest in what is being done by local interests to manage their basins as the State too plans a trans-California aqueduct to provide an additional supplementary supply and will encounter the same kind of problems. That's one of the important reasons you are here.

Now let's hear the experts!

The Orange County Water District has been a remarkable organization in what it has accomplished through cooperation and mutual agreement among a wide variety of interests that are represented in this county. They have avoided law suits and other legal

compulsion in accomplishing this program. Those of us who have watched for many years feel that the results have been very remarkable. I think probably the best-informed man on this subject in Orange County is the secretary-manager of the Orange County Water District, Mr. Howard Crooke, and I would like for him to talk to you at this time.

CHAIRMAN PORTER: Thank you. Before Mr. Crooke takes his place at the committee table or the witness stand, may I say I also neglected to introduce our representative attached to this committee from the Legislative Counsel Bureau, our legal advisor, Mr. Al Strong who is sitting in the front to the left. Mr. Crooke.

MR. CROOKE: Mr. Chairman and Members of the Assembly Interim Committee on Water, two of our staff members are passing out copies of this report and they will be available to assist in answering questions if needed.

It is a pleasure to have this opportunity of appearing before your committee today in behalf of the Orange County Water District and the Orange County Board of Supervisors.

I believe many of you are familiar with the methods and procedures we are using in Orange County to provide adequate supplies of water for our present and future requirements. We are most appreciative of the fact that when we have appeared before this committee and other committees of the California Legislature, we have always received a most sympathetic understanding of our water problems. This was true in 1933, when we asked for legislation creating the Orange County Water District, and it has been equally true each time we have appeared before you asking for amendments to our act.

As of November 1 of this year, we have received from the facilities of the Metropolitan Water District of Southern California, 849,875.1 acre-feet of Colorado River water at a cost of $9,710,934, all of which has been spread for replenishment of the groundwater supplied of the area of the district (plate 1). The major portion of the revenue to pay for this water has come from the replenishment assessments which the board of directors of the Orange County Water District has levied on all groundwater produced (plate 2).

Replenishment Program History: When the Orange County Water District was created by the State Legislature in 1933, it was charged with the responsibility of protecting and maintaning both the quantity and the quality of the underground water supply. The district comprises 201,000 acres, all of it within Orange County and overlying or adjacent to the coastal basin of the Santa Ana River drainage system, the largest watershed in Southern California. It is a semi-arid region. The average annual rainfall in the watershed as a whole is 18 inches, and in the district itself, 13 inches.

Sixty years ago, when Orange County had a population of only 25,000 and a very limited acreage in use for irrigated agriculture, the water supply was abundant. Artesian wells were flowing in many parts of the county. In Orange County, however, the pattern has been the same as in all other coastal Southern California communities. More and more people, industry, and commerce have been moving into the area, and the population in Orange County is now rapidly approaching the one million mark. Throughout this period of unprecedented growth, there has been a steadily increasing demand on the water supply. By some time in the 1920's, demand for

water had reached a point where it was equal to the available annual local supply. Since that time, demand has continued to increase far beyond the point of equilibrium, making it necessary to draw heavily on the groundwater reserve of the district.

During the ten years from 1941 to 1951, average water levels in the 3,500 pumping wells in the district dropped 38½ feet, and sea water had intruded into the basin as much as 4 miles on two separate 3 to 4-mile fronts. In an effort to relieve this situation and to stop many wells from going dry, the Orange County Water District in 1949 started buying Colorado River water to replenish the groundwater supply. At that time the water was released from the main feeder line of the Colorado River Aqueduct where it crosses the Santa Ana River in Riverside County. From there it was allowed to flow downstream approximately 25 miles into Orange County Water District as spreading grounds. In 1956, Metropolitan Water District completed a new feeder line into Orange County, making it possible to take delivery of the water at a point only 3 miles above the spreading grounds in the river. The geology of Orange County is such that water spread in the sand and gravel of the forebay area, where the Santa Ana Canyon widens and joins the plains, sinks rapidly and mingles with the groundwater supplies.

The district obtained its funds for the first purchases of imported water in 1949 from an ad valorem tax on real property that was then restricted to a top limit of 15 cents per $100 of assessed value. The ad valorem tax, however, with the limited property values which prevailed at that time, did not provide enough money to buy imported water in the quantities needed to offset the over-

drafts that were accruing annually on the district basin.

In the early 1950's, after eight years of below-normal rainfall, with population and industry increasing beyond all expectations, the problem became acute, and county leaders turned their attention to finding ways and means of raising money on an equitable basis to pay for more Colorado River water.

Expanded Program: A committee of twelve men, representative of the various economic and geographic areas within the district, was named to formulate a sound, operational water management program that would provide adequate supplies of groundwater for all the inhabitants and landowners of the district -- present as well as future -- and to do so by realistic financing shared on a proportional basis by those receiving either direct or indirect benefits. The plan the committee developed was to expand the basin recharge program under the authority of the Orange County Water District. It was designed to provide the necessary funds to purchase enough water to replace the annual overdrafts on the district basin and to raise water levels in wells high enough to stop further intrusion of sea water.

The recommendations of the committee were embodied in the amendments to the Orange County Water District Act that were adopted by the California Legislature, signed by the Governor, and made effective on September 9, 1953.

The 1953 Amendments: The changes in the Orange County Water District Act were, in effect:

1. The district authority was extended to include Anaheim, Santa Ana, and a major portion of Fullerton (within the boundaries, but previously not part of the district); as well as

Seal Beach and other areas along the west Orange County line. To provide adequate representation for all areas of the district, the board of directors was increased from seven members to ten.

2. The bonding provisions previously contained in the act were eliminated.

3. A new source of revenue was made available to the district, in addition to the ad valorem tax, in the form of a replenishment assessment or charge on the production of groundwater.

It was provided in the amendments that funds derived from the replenishment assessment -- or "pump tax," as it is referred to locally -- would be used exclusively for the purchase of imported water to replace the annual overdrafts on the groundwater basin. The top limit on the ad valorem tax rate was reduced from 15 cents to 8 cents per $100 of assessed value, with funds from this source to be used to defray the administrative costs of the district and to buy enough water to replace, in a period of from 10 to 20 years, the long-time accumulated overdraft on the district basin.

Program Operation: In operation, the replenishment program of the Orange County Water District consists of three major steps:

1. The district ascertains from an engineering investigation and report the probable overdraft on the district basin in the ensuing year. The act of 1953 spells out the specific information that must be contained in this report.

2. On the basis of the engineering report, and after holding two public hearings, the district may levy an assessment to provide funds for the purchase of imported water. An ad valorem tax, necessary to meet the requirements of the general-fund budget adopted by the district, is levied by the county board of supervisors

and apportioned on the county tax rolls affected.

3. The district buys water that originates outside the district, imports it to the spreading grounds, and adds it to the ground supplies. To date, the only outside source is Colorado River water from the aqueduct system of Metropolitan Water District.

In the initial phase of the program it was necessary for all producing wells within the boundaries of the district to be registered and identified in the district office. It was also necessary to work out a procedure for the orderly registration of new wells and old wells put back in production. The amendments provide that it is the responsibility of the individual operator to register his wells with the district. They further provide that the initial registration of all producing wells at the time the program went into effect was to be completed by January 15, 1954.

Collection of Assessment: After the assessment has been levied, all the registered operators of water producing facilities in the district are notified of the rate for the next fiscal year. Semiannually, in January and July, the operators are required to file statements of water production with the district, giving their production for the preceding six months, and to pay the assessment on the total amount of water produced.

With the exception of the so-called "small wells," the owners of all water producing facilities in the district are required to install and maintain on each facility a meter capable of registering the amount of water produced. Water production is determined and the replenishment assessment is paid on the basis of meter readings. If the water meter fails to register, then the

records of past pump performance, hours of operation, and energy consumption are all useful factors in making a reasonable estimate of the production. It is the operator's responsibility to keep the water meter in good repair so it registers correctly. The district has found it advisable, however, to employ a field man to make periodic readings of both water meters and electric-power meters. This information has proved to be helpful to the well owners as well as the district in administering the program.

The "small wells," which I referred to a moment ago, are exempt from the metering requirements. Operators pay instead a fixed charge replenishment assessment annually in an amount equal to the prevailing replenishment assessment on one acre-foot of water. The wells in this category have a discharge outlet not greater than two inches in diameter and provide domestic and irrigation water for an area not exceeding one acre.

The replenishment assessment rate levied for the fiscal year 1954-55, the first year in which the assessment was levied, was $3.50 per acre-foot of water produced.

In 1954, the board of directors filed an action in the Orange County Superior Court to establish the validity of the amendments under which the replenishment assessment was levied, and to determine whether the proceedings of the board of directors in connection with the assessment were in proper order. The action was contested by two groups of respondents. The court found that the assessment levied by the board of directors of Orange County Water District was valid. This decision was upheld in the appellate court, and the supreme court of California denied a petition for rehearing the case.

In the second year of the program, the assessment was again levied at the $3.50 per acre-foot. In each of the next three years the rate was $3.90 per acre-foot, and in 1959-60, owing largely to the increased cost of Colorado River water, the assessment rate was raised to $4.30 per acre-foot of water produced. Subsequently, the rate was raised to $5.50 per acre-foot for the fiscal year 1960-61, and to $6.00 per acre-foot for fiscal year 1961-62.

In the first seven years of operation of the program, the replenishment assessment collections totalled $5,350,000, all of which has been used to buy Colorado River water to sink underground (plate 3). During this same period the ad valorem tax has been levied annually at the full 8-cent rate provided in the amendments, and all moneys from this source not needed for administration and operation of the district have also been used for the purchase of Colorado River water.

Water Spreading Operations: To handle the large volumes of water being imported into Orange County Water District for replenishment of groundwater supplies (plate 4), the district owns approximately 800 acres of land for use as spreading grounds. The largest area is the 725 acres in the Santa Ana River channel, which overlies the recharge portion of the district basin. The district tries to maintain the spreading grounds in the riverbed in such a way as to obtain the greatest possible amount of percolation from both the natural flow of water from upstream and the Colorado River water that is discharged into the river.

The facilities in the Santa Ana River are being supplemented by spreading sites outside the river channel. One of these consists of 25 acres, portions of which have been excavated to a depth of 20

feet, and you did not see this one on your tour yesterday, and is currently in use for sinking water. The other, a 65-acre site, is being excavated to a depth of 50 feet, and part of it, as many of you observed yesterday, is now in operation.

Metropolitan Water District has built a 300 c.f.s. capacity feeder line to this 65-acre site. This feeder will also supply water for spreading in many of the Orange County Flood Control District facilities which overlie the forebay portion of our groundwater basin. All of these flood control facilities are being made available to our district by the Orange County Board of Supervisors in the interest of obtaining the greatest amount of benefit from the expenditure of tax funds. Private agencies are also cooperating with Orange County Water District in achieving a common goal of adequate groundwater supplies. The Anaheim Union Water Company, Santa Ana Valley Irrigation Company, and the Irvine Company are making their water transportation facilities available to transport Colorado River water to water spreading sites located on their properties. These facilities are being made available to the water district free of charge, the only cost to the district being the cost of water received from Metropolitan Water District and the actual handling of the spreading operations.

With these additional facilities for water delivery and spreading, it is now possible for the district to receive and sink larger volumes of water underground than heretofore. Also, a large portion of the water can be received during the winter months when the demands for Metropolitan Water District water are the lowest. The riverbed then has a chance to dry out during the summer months and is in better condition to absorb a larger percentage of the winter and

spring runoff, and I might add, when we get it.

Water Levels: The groundwater replenishment program of the district has been successful in halting the steady decline in water levels in the district basin that occurred year after year before the large-scale importations of water began in 1956. A groundwater contour map as of November 1, 1960 shows water levels to be, on the average, higher than they were in 1956 (plate 5).

From data now being assembled for the annual engineering report on groundwater conditions in the district basin for the water year 1960-61, it is indicated this past year was the driest year of record, with the Orange County rainfall index 31.5 percent of the long-time average. The flow of water at Prado Dam was also the lowest of record, being 9,000 acre-feet less than the previous year when it was also the lowest of record to that time. Rainfall and the flow of water at Prado Dam constitute most of the total natural supply to the district basin. Even though the district imported 140,388 acre-feet of Colorado River water for groundwater replenishment during the water year 1960-61 (plate 4), in the face of the adverse rainfall conditions, there is every indication that the groundwater contour map as of November 1, 1961, when it is completed, will show a decline from the average water levels of a year ago. This points up the immediate need for the district to increase its water importations.

Availability of Colorado River Water: With the completion in 1960 of its $200 million expansion program, Metropolitan Water District has enough capacity in the aqueduct system to transport into Southern California its entire annual contract allotment of 1,212,000 acre-feet of Colorado River water. Although Orange County

Water District, for the time being, can get as much Colorado River water as it has money to buy, no one knows how long this will be the case. According to Harvey Banks, former State Director of Water Resources, Orange County last year received approximately 2½ times the amount present trends indicate its ultimate allocation of Metropolitan Water District's Colorado River water may be. Orange County is now receiving water not needed by other member agencies of Metropolitan Water District. When those agencies need all the water they are entitled to, Orange County's allocation may be cut back to a proportionate share. This will probably occur when the need for imported water in Orange County -- according to the estimates by the State Department of Water Resources and others -- will have approximately doubled and before water from the State water facilities is available in Orange County.

The 1961 Amendments: Realizing the present sources of revenue would not be sufficient to buy increasingly larger quantities of supplemental water to meet the increasing demands and also add to the reserves in storage, the district again went to the Legislature in 1961 and obtained approval of further amendments to the district act. One amendment, which carried an urgency clause and therefore was effective upon the Governor's signature on April 4, 1961, provides for an increase in the allowable ad valorem tax for four years beginning in 1961-62 to 20 cents per $100 of assessed value, with a cutback to a limit of 15 cents per $100 for the following six years, after which, in 1971, the ad valorem tax limit will revert to the 8 cents per $100 limit provided in the 1953 amendments to the district act. This amendment requires that all funds accruing from a levy in excess of 8 cents shall be placed in a water reserve fund to be used

only for the purchase of imported water.

The maximum ad valorem tax rate of 20 cents per $100 has been levied for fiscal year 1961-62. As previously stated, the pump tax for the corresponding period is levied at $6 per acre-foot of water produced. With the funds from these two sources, the district plans to buy and sink underground at least 210,000 acre-feet of water in 1961-62. The board of directors of the district has also declared its intention to continue buying Colorado River water at this rate as long as Metropolitan Water District can provide it, in order to build up the basin reserves for use until the next supply of supplemental water is brought from the north.

At the 1961 legislative session, the district also secured adoption of an amendment which permits the levy of an additional pump tax, at the discretion of the board, on the production of water for non-irrigation uses. This assessment, if levied, would be over and above the rate assessed on the production of all water from the district basin as provided in the 1953 amendments, and would tend to equalize the cost of water which is produced from the groundwater supply for other than irrigation purposes and the cost of water delivered direct from the facilities of Metropolitan Water District. In 1960-61 the cities and other agencies in Orange County received over 83,000 acre-feet of Colorado River water direct from Metropolitan Water District's delivery facilities. If the board exercises the power to levy the additional assessment on the production of water for other than irrigation purposes, it will have the effect of encouraging even greater direct use of Metropolitan Water District water by cities and others, and to that extent will relieve the draft on the

underground basin.

Sea Water Repulsion Projects: Looking forward to the early 1970's, when it is indicated the demands for water from Metropolitan Water District will be equal to or greater than the available supply from the Colorado River and water from the north may not yet be available in Southern California, it will again be necessary for the district to rely heavily on its reserve supplies in the groundwater basin. This will cause water levels to be drawn down lower than they ever have been, and if left uncontrolled, sea water will make greater inroads into the district basin. For this reason, investigations and studies have been under way to find the most practical means of halting sea water intrusion. These investigations are being accelerated. The State Department of Water Resources has also been authorized to expedite the studies in the Santa Ana Gap with its resources and personnel.

Conclusion: This, in general, is an outline of some of the activities of the Orange County Water District in carrying on a water management program for the area of the district and, in brief, what is planned for the immediate future. With the experience we are gaining through our groundwater replenishment program, we believe we will have the necessary basic data and information that are fundamental to the development of a sound program for the long-range future.

Note: (Plates submitted by Mr. Crooke are on file at the Water Committee Office, Room 2114, State Capitol).

ASSEMBLYMAN LEVERING: Thank you, Mr. Crooke. Are there any questions by members of the committee?

ASSEMBLYMAN BEAVER: Yes, I have one.

ASSEMBLYMAN LEVERING: Mr. Beaver and then Mr. Z'Berg.

ASSEMBLYMAN BEAVER: Referring to your plate 2 for a moment, I'm sure you have one there handy, on the last line, 1961, I assume that parenthesis means in both those cases that this is a figure through October this year. I note looking under "purchased from" that you purchased 36,407.8 acre-feet of water from the general fund and you purchased 84,679.5 acre-feet of water from your replenishment fund which would indicate to the committee and I'm sure it is accurate that your well pump uses tax of $6 under your current schedule is buying on the ratio of two to one of the total amount of water that you are importing to the underground basin. Is that correct?

MR. CROOKE: No, that is not exactly the correct assumption because back about 1956 when Metropolitan Water District was strenuously endeavoring to get their construction program accelerated, and $200 million dollars is pretty difficult to spend too quickly, we could not get the water we wanted. They just didn't have enough pumps and capacity to bring it over, so we kept right on levying a pump tax so we would have the money to replace the water being drawn out then so we had quite a considerable carryover of money in the replenishment fund. The replenishment fund now I think is geared to buy about half the water which will take care of the annual overdraft for the next very few years. The general fund money will buy water to put underground to replace the long-time accumulated overdraft and bring the storage back up. So we had a heavy carryover.

ASSEMBLYMAN BEAVER: That means, however, that with respect to financing your underground recharge basically it will be carried by the property owners and not by the pump fund in the future?

MR. CROOKE: No, it means that the pump money will generally speaking be equated out to average rainfall conditions which we haven't had and will provide the revenue to replace the annual overdraft. The general fund money will provide the money --

ASSEMBLYMAN BEAVER: For the long-term replenishment?

MR. CROOKE: Yes, and refilling the basin.

ASSEMBLYMAN BEAVER: I see. Thank you.

ASSEMBLYMAN LEVERING: Mr. Z'Berg.

ASSEMBLYMAN Z'BERG: Mr. Crooke, are the boundaries of the district coterminus with the boundaries of the basin?

MR. CROOKE: No, sir, because there are many definitions of groundwater basins, many many different definitions.

ASSEMBLYMAN Z'BERG: Yes. Well, the reason why I ask that is this suit that you say determined the validity of the amendments, was this a friendly type suit or was it an adversary type?

MR. CROOKE: It wasn't exactly friendly, no, sir.

ASSEMBLYMAN Z'BERG: Well, let me ask you this then, were there some people who were saying then, "I'm in the district, but I'm not in the area of the beneficial use of the water because the basin doesn't extend to me"?

MR. CROOKE: No, the suit was a little different as I understand it, the fundamentals in it. Many people felt and particularly the farmers, that all the money should come from an ad valorem tax and the high assessed value, the city, should pay for the water. That was the basis of the suit.

ASSEMBLYMAN Z'BERG: Apart from that then I assume on any particular given -- well, it is pretty difficult to tell what portion

of that water that is being pumped out of there is water which would have been there without your replenishment program and what part is attributable directly to the replenishment program, so in order to have this whole operation in effect did you first have to have a determination of water rights?

MR. CROOKE: No, sir.

ASSEMBLYMAN Z'BERG: Within the county?

MR. CROOKE: There has been no determination of the individual water rights of the respective owners in Orange County.

ASSEMBLYMAN Z'BERG: Well then, isn't it quite possible that some people who are pumping water are getting less benefit out of the recharge program than others and therefore in effect they are subsidizing or helping the other one?

MR. CROOKE: I think we get quite confused between water rights and water as a physical commodity which is needed. Could I take time and tell my own personal story? I think it might clear it up.

CHAIRMAN PORTER: How personal is this going to be?

ASSEMBLYMAN LEVERING: How long is it going to last?

MR. CROOKE: It will take two minutes. Mrs. Crooke and I own three beautiful marvelous holes in the ground. We are the sole owners. Two of them are better than a mile deep and under all the laws of the State of California we have every right to pump all the oil and gas we can out of those holes. There just isn't any in them. The right does no good because there is no commodity. The third hole is a water well, beautiful casing in that thing and again it is located on a piece of ranch property we own where we raise oranges

and avocados, and under the laws of the State of California correlative with others, we have every right to take the water we need from that well to irrigate these trees, but there is no water in the hole. My trees will wilt even though I go up and down the row and tell them that this is my water right. They have got to have water. It is water we want. Our people are convinced of that in Orange County.

ASSEMBLYMAN SCHRADE: And the trees, too?

MR. CROOKE: And the trees, too.

CHAIRMAN PORTER: These are the wells you have been trying to sell me stock in for the last three years.

ASSEMBLYMAN Z'BERG: One of the reasons I ask these questions is because you have solved your problems down here pretty well and everybody seems to be getting along fine. We are also studying how your program might be applied to other areas of the State and the valley and I'm trying to anticipate some of the problems we will run in to. Now, if the boundaries of the district aren't coterminus with the water basin, then was one of the allegations in the suit that some people were being required to pay without getting any benefit? Is that it?

MR. CROOKE: Generally speaking the boundaries of the basin are coterminus with the area which has been served by wells in the basin. Because some of this area around what might be called the basin -- again we get back to definitions --has built an economy by having wells in the basin and they have rights. Also there will be other areas developed and that is the thing that I think we are going to have to get into as the future comes along because you only have so much groundwater basin. Are we going to limit our economy to those

areas or are we going to allow these economies to expand and permit utilization of water from these basins which in reality will be terminal storage reservoirs? I think we have to get a lot of experience and get a meeting of minds of our people.

ASSEMBLYMAN Z'BERG: Now, your district has the authority under the act to tell any particular well owner, any landowner that you can only pump so much in any given time?

MR. CROOKE: No.

ASSEMBLYMAN Z'BERG: You don't, so they have the right to pump as much as they want?

MR. CROOKE: Yes, but we watch very carefully to be certain the water is going to beneficial use and is not wasted.

ASSEMBLYMAN Z'BERG: But assuming that they are, you don't have that power at the present time?

MR. CROOKE: No.

ASSEMBLYMAN Z'BERG: I see.

MR. CROOKE: We don't think we need it at the present time because we have six cities in the county who are now taking half of their water direct from the facilities of Metropolitan Water District and three of these cities have done that since 1941 when the water was first available. Others are joining them and they are all pulling together on solving this common water problem.

ASSEMBLYMAN Z'BERG: Thank you.

ASSEMBLYMAN LANTERMAN: Mr. Chairman, may I just point out before I have to leave to Mr. Z'Berg that to my knowledge there is only one water basin under adjudicated management in our area or in the State for that matter and that is the Raymond Basin which they

can see at the top of the map over there right in the center if they will turn the map around just a little bit. That is by court decree. You are not permitted to withdraw only so much water according to the capacity of the basin which was determined by the State Water Department and the courts. It is under a watermaster regulation and we cannot withdraw only that which we are entitled to by court adjudication. It is the only basin I know of under adjudication.

ASSEMBLYMAN Z'BERG: Could I ask Mr. Lanterman, was that a stipulated judgment, do you know?

ASSEMBLYMAN LANTERMAN: Yes.

CHAIRMAN PORTER: Thank you.

ASSEMBLYMAN NISBET: There are some that are voluntary. They have voluntarily agreed, but there is no adjudication except that one.

CHAIRMAN PORTER: Any other questions? Mr. Benedict has a question.

MR. BENEDICT: Mr. Crooke, following up on Mr. Z'Berg's question, you stated that there was no limitation on pumping within your district and that there has been no determination of individual water rights and that your district generally speaking is coterminus with the groundwater basin that you operate. However, you do get some supplies of water, natural inflow underground along the Santa Ana River into your groundwater basin, do you not?

MR. CROOKE: Some.

MR. BENEDICT: And there has been some adjudication of the rights between your district and upstream areas to this underground flow?

MR. CROOKE: Right.

MR. BENEDICT: So that you have had to -- the only area where you have had to undertake any adjudication of water rights is where you had rights that were outside of your district?

MR. CROOKE: That is right. Actually what occurred in that situation was, and again the definition of a groundwater basin is a little bit vague -- even the water department finally concludes there are areas for convenience of study. I'm talking possibly more in the area of sub-basins. The bulk of the water falls in the mountain areas. We have developed water rights and our district represents all our people and land owners. The people upriver have developed water rights. The watershed is now in an overdrawn status according to the court. So all we are trying to do in that case is say "Quit stealing the water and let our water come on down to us." We asked the court to determine those and see that they didn't exceed those rights to our disadvantage, so the adjudication has taken place where the water first comes. Is that properly stated?

ASSEMBLYMAN BEAVER: I think that is very succinct.

CHAIRMAN PORTER: Thank you very much, Mr. Crooke. You have sustained our high opinion of you again in the successful operation of your basin here.

MR. CROOKE: Thank you, sir.

ASSEMBLYMAN SUMNER: Mr. Chairman, I might observe that having watched Mr. Crooke that one of the reasons the Orange County Water District has been so successful is because of his ability to mold people together and get them to work together. That is probably one of the biggest factors in making the whole system work.

CHAIRMAN PORTER: Even lawyers and engineers.

ASSEMBLYMAN SUMNER: Yes, you see he confuses the lawyers and confuses the engineers and the first thing everybody is working toward the goal.

CHAIRMAN PORTER: That is a noble achievement.

MR. CROOKE: Thank you, sir.

ASSEMBLYMAN LEVERING: You better put him in the United Nations.

MR. CROOKE: That is quite a statement from an attorney. I thank you.

CHAIRMAN PORTER: I don't know why you are letting him retire from the Legislature. You should draft him or something. Now, we will recess for lunch and we will reconvene at 1:15.

(Thereupon the noon recess was taken.)

WEDNESDAY, NOVEMBER 29, 1961, 1:30 O'CLOCK, P. M.

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CHAIRMAN PORTER: We will now reconvene our meeting. I'll turn the meeting back to Warren Butler at this time.

MR. BUTLER: Thank you, Mr. Chairman. Long before we had the machinery or the money to buy Colorado River water or it was available with which to do this replenishment work, the Los Angeles County Flood Control District was already providing spreading grounds and other devices with which to catch the natural flow of water after heavy rains and otherwise. This activity made it a natural that when we got into the new program that they were to do the physical work involved. The man who has had many years of experience with this work is Finley B. Laverty. He is the assistant chief engineer of the Los Angeles County Flood Control District and I would like to have him address you at this time.

MR. LAVERTY: Thank you, Mr. Butler. Chairman Porter and Members of the Committee, the subject which has been assigned to me in this group of talks relates to water conservation in Los Angeles County and what has been done and what is planned for the future. Mr. Crooke told you about the program in Orange County and particularly about the use of imported water to build up the groundwater table. I'll talk about the conservation of local water by spreading in Los Angeles County, conservation of imported water, barriers to sea water intrusion, waste water reclamation, and I'll try not to repeat what was given to the committee in some detail yesterday. Yet I'll have to get into parts of that again.

In order to give you the best picture of this as quickly

as we can we are going to show pictures along with the talk. I want to say that all of the pictures and charts will not be explained. Now, I'll merely mention it is a sequence of a type and I think you will get the rest from the slides. As Mr. Butler indicated, water conservation of Los Angeles County is not new. The Flood Control District was formed in 1915 but this was more than 20 years after water conservation had started at the mouth of San Antonio Canyon through the acts of mutual water companies. The district's duties are both flood control and water conservation, but this talk will be all about the water conservation and not the flood control duties of the district.

The need for water conservation and groundwater replenishment, and this will be apparent as I go along, but I would refer you back to what has been said by Mr. Howlett as to the nature of the groundwater basins, the overdraft of the groundwater basins and the considerable need to replenish that overdraft. The district carried out its water conservation duties in several ways. We conserve mountain runoff regulated by 14 major dams. We conserve some valley runoff utilizing gate structures and channels down in the valley to divert water to off-stream spreading grounds. We conserve water in the valley in pervious channels. We purchase imported water. We are working to save the groundwater storage against sea water intrusion and as he mentioned reclamation is a job.

It has taken a great deal of basic data in order to get at this job. Ever since the late 20's the district has been carrying on a hydrographic program that is rather large. It has probably the largest number of rain gauges in any section in the world concentrated in Los Angeles County, nearly 700 gauges are cooperatively reported.

We have a large stream gaging system which is carried on. We measure wells, we sample wells, and of course the groundwater work requires a great deal of study of geology as well as a study of water supply economics.

Now, if we may have the lights out we will take off with some of these slides. Here we have a map of the Los Angeles County area on the coast side of the mountains and it is being used just to give you an idea of the scope of the district's water conservation activities. Each one of the names on the map represents spreading ground locations from over here at the eastern end of the San Fernando Valley and on across including such spreading grounds as Pacoima, Tujunga, Arroyo Seco, Eaton, Arcadia, Sawpit, San Antonio and we also cooperate in the operation of about 500 acres of spreading grounds throughout the San Gabriel Canyon, so that the district all told has some 1700 acres of spreading grounds of its own and cooperates in the activity of operation, and maintenance on some 1400 acres of additional spreading grounds. The largest spreading grounds of the district are at the Rio Hondo and the San Gabriel where the committee saw the grounds yesterday and saw imported water being spread in the San Gabriel River.

You will recall that the major groundwater basins of the area as Mr. Howlett brought out are the San Fernando Valley, the Coastal Plain in which we have the Central Basin and the West Basin seaward of Newport and up above Whittier Narrows where we stop at the dam, the upper San Gabriel Valley Basin which we call the Main Basin of the San Gabriel.

Since 1930 the district has spread in its spreading grounds

some 314,000 acre-feet. On the average of twenty dollar value per acre-foot this is some 3700 dollars worth of water per acre of spreading ground. This is despite the fact that the majority of these grounds have been constructed since 1940 and our wet period ended in 1944. We have had 17 years of dry weather since except for two above-normal years.

Now, let's concentrate on the spreading of local runoff. Here you will see a sequence of pictures going from San Gabriel Canyon down to the San Gabriel River, to the Rio Hondo spreading grounds. This is an example of the spreading of mountain runoff regulated by dams and we come to the end of this sequence where downstream you will see the gates that some of you saw yesterday at Rio Hondo. This is an example of a place where we can do both runoff from mountains and valley runoff, and we spread water up to a flow in the channel here of about 2,000 second-feet. Now, we will show you a sequence in a smaller stream a little bit later here, Santa Anita Canyon. Before we get to that here is a rather dark picture of Rio Hondo spreading grounds, and this is a picture of the San Gabriel spreading grounds and the water in the San Gabriel River is being spread behind checks that are put up by bulldozers temporarily and washed out by large floods and replaced. Now, here is a spreading intake in a mountain canyon of little Santa Anita Dam where we take the water out from a pipeline and put it in a pipeline and carry it to the spreading grounds, an example of some of the small mountain spreading ground intakes and the sequence that goes with it. In addition to the several surface spreading areas in which we have basins of this type varying all the way from a part of an acre to as much as 17 acres per

basin, we have-- this is Arroyo Seco -- we have spreading pits. Here is an example of a spreading pit and here the percolation is primarily in the walls of the pit. This pit has been in use ever since the late 30's. It is an abandoned gravel pit in rather coarse material. It doesn't make any difference whether the water that comes in is silty or not, the silt settles to the bottom and percolation continues to take place in the walls of the pit. The walls are washed by the natural wave action in the pit and continue to percolate at high rates. Now, the ability to spread, of course, as far as local water is concerned varies a great deal with the rainfall and I think possibly this will be of interest to you because it does show the difference between what we get in wet years and what we get in the number of dry years that we have had recently.

As an example, in 1957-58 we had 167 percent of normal rainfall in Los Angeles County and in 1958-59, the next year, only 51 percent. The earlier year gave a 190 percent of normal runoff, the dry year 35 percent of normal runoff. You get the comparison between the two not proportionate to the rainfall, a great deal greater change in the runoff characteristics. In 1958 we were able to conserve in spreading grounds over 90,000 acre-feet while in 1959 we only conserved 13,000. At the same time we conserved in streambeds in 1958 about 205,000 acre-feet and in the dry year only 25,000. So that the total for that year was 296,000 acre-feet for 167 percent of normal rainfall against 38,000 acre-feet for a 51 percent of normal rainfall year.

Now, let's talk for a bit about the spreading of imported water, the next stage of the district's endeavors. I don't know how

well you can see this map, but what it does is to give an indication of the location of the Metropolitan Water District's supply lines. From out at the end of the San Gabriel Valley two lines diverge which can carry treated water from the treatment plant which is normally in the upper feeder along the edge of the mountains or through this middle feeder over to the hills near Whittier Narrows where you were yesterday. Then a good deal of the time the middle feeder is not yet totally required for treated water and so we can take water through it which is raw water at a considerably cheaper price. This water is discharged into the San Gabriel River above the San Bernardino Freeway at this point and into Alhambra wash where we saw it yesterday at this point, and we see one flow comes down the San Gabriel River through Whittier Narrows and the other comes down the Rio Hondo and are spread in the spreading grounds in the streambed below. The benefits, of course, as you have been told by Mr. Crooke of spreading this imported water is to insure a source of water in case of a man-made disaster, to insure a source of water until Feather River is available, but very importantly to insure that we have the groundwater for peaking supply under all conditions.

Here we have a bar graph which shows the experience of the district in spreading water. In the year that we started, 1954, some 54,800 acre-feet was spread. The next year a little less was spread and you will see the bars moving along there until 1960-61 we spread 142,000 acre-feet and probably will equal or exceed that during the fiscal year 1961-62. So far the district has purchased either through its own or in cooperation with the water replenishment district 582,000 acre-feet and spread this water.

Now, how is this program financed? I won't go into that in too much detail because we discussed it a good deal on the bus yesterday. We talked about the water conservation zone which has a 5 cent tax rate and in the Central Basin area can raise better than $800,000, probably between $900,000 and a million dollars, to purchase water at $12.75 per acre-foot, and then the pump tax of $5.50 of the replenishment district to purchase additional water.

The sequences that you are seeing are the delivery of this imported water. I mentioned to you yesterday that this zone one was a temporary measure and that is why it was so important to establish the replenishment district, but despite the fact it was a temporary measure it has seemed so important to the people in Los Angeles County to have the funds to get as much water as possible that this zone has been re-established just in the past month for the third time so that it will extend now through June of 1967. With the increasing price of Colorado River water, it will still continue to be able to purchase about 75,000 acre-feet a year.

With the pumping assessment of the Central and West Basin Replenishment District it is expected that we can get a total of in the order of 250,000 acre-feet a year if that water is available. There is a question, as I indicated from the dual use of these lines for treated water supply and imported raw water supply whether we can get that much water delivered. In order to deliver it we are having to spread right straight through the storm seasons and this requires a considerable amount of operation to do it.

Now, let's talk about barriers to sea water intrusion.

For the past 17 years we have had this heavy withdrawal of

groundwater. Prior to that time we had still heavier withdrawal in comparison because during the war years there was no imported supply available and industry was enlarging in this area at a tremendous rate. Therefore there was a drop in the water table in the West Basin where we were yesterday in the early 40's down to 60 feet below sea level some 45 miles inland from the coast. The early evidences of sea water intrusion, however, were as early as 1920 in Santa Monica and in the Manhattan Beach area in the early 40's, and in the Los Angeles Harbor area in the late 40's and of course this sort of thing is inevitable where there is tremendous pumping inland.

I indicated to you this morning I believe that the overdraft in the Coastal Plain of Los Angeles County has increased from 70,000 acre-feet a year to 200,000 acre-feet a year in the 10-year period from 1945 to 1955. During the period from 1955 to 1960 the pumping in the Coastal Plain area increased from 300,000 to 354,000 acre-feet per year, and this increase in pumping you see is greater than the amount of water which we can currently have available from the Metropolitan Water District. It makes it very important that as much water as possible be taken on the surface as well as underground and that we have all means available to build up the groundwater supply.

In the Coastal Plain groundwater levels are below sea level over 80 percent of a 460-square-mile area. In Vernon the water table is more than 100 feet below sea level. That is a considerable distance in from the coast as you know. Now, on this map, we have shown these various basins and the barrier areas which we are talking about now. This is the Santa Monica Bay and it reaches from Palos Verdes

hills up to Playa Del Rey, an 11-mile stretch, in which the existing barrier at Manhattan Beach is one and a half miles long, which is shown at this location. This is Dominguez Gap where sea water intrusion is coming in through devious paths of the upper sands and gravels and is approaching the very important Silverado Aquifers without any apparent place to stop that path. Then we talked about the barrier at Alamitos Bay that we didn't see because of the fog yesterday. It was in that area where we traveled so slowly when we crossed the San Gabriel River, This again has been a matter of a long-time study. There has been a lot of cooperation between the cities along the coast and the Flood Control District and the Metropolitan Water District and other agencies in trying to work out the problem. One of the other agencies is the United States Geological Survey and, of course, another is the Department of Water Resources.

In 1943 the United States Geological Survey groundwater division was asked by the Flood Control District of the cities of Inglewood, Redondo Beach, Manhattan Beach, El Segundo, Hawthorne, Culver City, Gardena, Hermosa Beach and the Palos Verdes Estates, just to give you an idea of the cooperation in the area, and they furnished the dollars to come in and study what could be done in order to stem sea water intrusion. The United States Geological Survey gave some five means of doing the job and out of that group one seemed practical to the Flood Control District, the means which you saw yesterday of injecting water through wells, although at that time we hadn't much experience in that particular method, and so in 1950 the district experimented with Manhattan Beach with help from the University of California Los Angeles and some water technologists found that by

chlorinating the water so the slimes underground would not build up from the spores that had been there for thousands of years and will be active once oxygen gets to them, by chlorinating these formations we found we could inject water for long periods of time in amounts of 1 to 2 cubic feet per second per well.

We told you yesterday that the Department of Water Resources prepared a list in December of 1950 of the serious intrusion in 13 areas along the coast of California and that the most serious intrusion the department said, was in the West Basin of Los Angeles County and the Central Basin in Orange County.

In 1951 the Legislature granted $750,000 to undertake means of field test and lab means of working on this problem. That money was expended to a contract with the Flood Control District for eight tenths of a mile of recharge wells, with the United States Geological Survey for further studies and with the University of California for further studies.

As a result of these studies we had a successful barrier operation in the West Basin area. Now, it is probably rather difficult for you to see the legend up here in the corner, but what this is is a picture of the movement inland and the seriousness of its travel inland, taking over groundwater surface storage on the part of sea water. The yellow is the status of intrusion in 1931. The red is the increase by 1950 after that period of war years, I imagine, and by 1961 we had this still further increase of intrusion and this is the location of the present mile and a half of barrier.

CHAIRMAN PORTER: Could I interrupt you. In terms of

distance could you tell us how far inland those green humps are?

MR. LAVERTY: This scale right here is miles and you will see that this is easily two miles inland from the coast so that we have got up to this point about a mile and here is another mile, so that we have intrusion in various spots along here up to in this case nearly three miles inland. Does that cover your point?

CHAIRMAN PORTER: Yes, I just wanted that in the transcript.

MR. LAVERTY: Well, as I mentioned, this test project under contract with the Department of Water Resources and the Flood Control District was completed, injecting through 9 wells and this turned out to be able to form a barrier, so that we are sure about this barrier business. I want to talk just a moment about that.

You will all, I think, visualize if you inject water through a well and it is injected, as we talked about yesterday through a clay cap, it will spread out from that well under the clay cap as a pressure movement and if another well over here does the same thing eventually that pressure movement will join so that the sag point in between these two wells is the measure of the level of the point which creates the reversal of slope to being inland and sea water moving in, to having water moving out toward the ocean and therefore having a very slight gradient which stems the sea water intrusion from coming in from the ocean. Now, this is effectively what is being done with these wells and what we have maintained ever since 1954 when the test operation ended, and as I mentioned, that's been extended to a mile and a half along the coast now. I'm not going to go into the details of this matter of intrusion too much because you had these charts in your folders yesterday. You know that water

is injected through the clay cap into the aquifer underneath and what has happened is a movement of the groundwater both toward the ocean and inland and that the largest part of the supply moves inland. In fact, none of the fresh water has wasted to the ocean so far and we don't think that there is a possiblity of over 5 percent of the injected water being wasted to the ocean.

CHAIRMAN PORTER: Why would that be?

MR. LAVERTY: The gradient is so flat from the 3 to 5 feet above sea level that it is necessary to maintain the water at the point between the wells so that the movement toward the ocean in the wells that we have sampled shows that we have not yet had the fresh water reach the 1500 foot well and the injection line is some 20,000 feet inland from the ocean at its closest point. On the other hand the gradient inland is very steep.

Wells for pumping in this pressure formation pump from 60 to 100 feet below sea level inland and so there is actually a tendency for the majority of the water to move inland and be a replenishing source. We have injected over 30,000 acre-feet of water through these wells since the initiation of the project. The current rate of injection is 4,750 acre-feet a year.

At the present time the area of intrusion which you saw on that chart that I described in the various stages covers 8100 acres along the coastal fringe of the basin. So this is the important thing as far as development is concerned.

Now, here is the sequence of slides showing the mile and a half development at Manhattan Beach at the present time and the continuing development. This shows the more recent additions and I

believe brings us up to 1961 with the red there.

Now, what is in the cards for the future. This is the 11-mile barrier you see, nearly 5 miles on each end that have to be added and of course this is the work which the district is undertaking at the present time. Now, what is this expansion plan? The expansion plan requires water to come from the Metropolitan Water District Aqueduct in a line which is already constructed on El Segundo Boulevard and then through lines which are being constructed by the district to distribute water along the coast. The largest supply line goes down to the Torrance area where you were told yesterday the greatest rate of input will be. The input to this barrier total will be about 75 second-feet. It may be as much as 65,000 acre-feet per year and the water which it injects, as I said, 95 percent of it will be conserved. Now, this doesn't mean to say that this isn't an expensive proposition. If it weren't for the preservation of the basin, it wouldn't be worthwhile because it costs us $30 to $35 an acre-foot capital cost, maintenance and all, plus the cost of water at $20 an acre-foot of treated water to inject the water into the ground, but if you stop to consider that if we didn't have this basin for groundwater storage we would have to provide the peaking storage, the emergency storage all above ground in constructed works and these works cost between $10,000 and $20,000 per single acre-foot to construct, and we don't have reservoir sites left and most of the area is covered by houses and industrial sites so water storage is a very expensive proposition, so it is very important that we continue to preserve this groundwater basin.

Now, the second area of intrusion that I would like to

talk about, the second in importance, is the Alamitos Bay area. Here we have the San Gabriel River coming down to the coast which is also about the same thing as the line between Orange County over here and Los Angeles County over here, and we have the sea water intrusion as it existed in 1945 right here. Here is the Inglewood-Newport Fault. At that time studies of the Geological Survey and the district showed that the water had just reached over the fault. Now, you heard yesterday how that came in through a layer of sand that is continuous out to the ocean. Now, here we are in 1956 with sea intrusion having taken this shape and I think there is one more chart, and here is the present sea water intrusion both sides of the river, this green area, so that again in a scale up here we have 2,000 feet and we have several miles you see inland from this, what used to be the barrier to sea water intrusion, the Inglewood Uplift, and the water which came from the inland and capped the recent formation kept the sea water from coming in. This, of course, threatens the water supplies, the pumping supplies of a considerable development on the Orange County side and the development of Lakewood and Long Beach on the Los Angeles County side.

The preliminary planning for this barrier has been completed and the geology of course was completed ahead of that. Reports are available and completed on the geology and nearly completed on the plan. This barrier is estimated to cost some $3,600,000 . This is over and beyond the cost of the Metropolitan Water District pipeline projected to carry water down to Signal Hill and it is necessary to bring a supply line from that point over to the center of the barrier and then as we discussed yesterday set up a line of

barrier wells in a circle, primarily around this sea water intrusion to the Inglewood-Newport Uplift in order to surround the intruded water and form an off-shore gradient to prevent further intrusion.

The third area of intrusion I'll just mention very briefly is a t the harbor area which we call the Dominguez Gap. This is a combination of industrial waste in the groundwater and sea water intrusion. This is the condition it had in 1934. By 1961 there had been these additions to this intrusion. This is all through an upper aquifer . The Silverado Aquifer below is not intruded and seems to be fairly well protected but at the present time we are a bit worried about that because our geology indicates there may be a connection between these upper aquifers and the Silverado Aquifer. Now, what is the total cost of these areas and this program? I told you that the West Basin barrier would be completed possibly in 1965. The Alamitos barrier we hope to undertake within a year to a year and a half as a joint operation with Orange County, and Dominguez barrier will be further along in the undertaking. So we are looking at a considerable endeavor.

The cost of the three barriers is estimated to be some 25 million dollars including the supply lines to the barrier, the recharge wells, and the annual cost of water for these three barriers would be approximately $1,500,000, and the annual cost of maintenance would be about $625,000. It is not cheap, but it is an important job to be done in preserving the basins.

Now, I'll wind up here very shortly with just a few remarks about water reclamation. You will recall that we talked about the potential for water reclamation yesterday. A report was put out in

1958 by the County Sanitation District and Flood Control District and I presume Mr. Farquhar who follows me will talk more about this, but essentially an important finding was that there is a considerable amount of domestic wastes which are easily susceptible to treatment.

Currently there are some 465 million gallons per day of waste waters going to the ocean. Of that about 60 percent, 280 million gallons a day, are amenable to reclamation and reuse, and of this we consider that there is a location for reuse of about 240 million gallons per day. Now, that was in 1958 when we had the 465 million gallons per day waste into the ocean. Now the waste to the ocean is 540 million gallons per day or 75 million gallons more in a three-year period.

To understand the role of reclaimed water it should be noted that 280 million gallons a day is about 300,000 acre-feet per year, which is 25 to 30 percent of the present requirements of coastal Los Angeles County. In other words, this never could be a means of supply to the county, but it is a very important adjunct to groundwater replenishment.

Now, there are two ways that reclaimed water can be used. One way is to spread the water on the surface of the ground. This is what is going to be done with the water which you saw, which you were told about coming out of the treatment plant at Whittier Narrows. The other way is to work on the basis of injection through wells. You were told yesterday at the Hyperion Plant that this requires a treatment which makes practically drinking water standards out of the effluent from the sewage treatment plant. Here is the Hyperion Plant which we saw with the primary part of the plant in the background

where there is now the ability to discharge the sludge through a 7-mile offshore line and the water just treated in the primary plant through a 5-mile line offshore, but the old part of the plant which was used for fast activated sludge treatment is now available for a better grade of treatment for about 100 million gallons a day, about 150 second-feet. And this is the aeration area. This is the sedimentation area of the plant, and the next slide shows the work that was done in 1955 to 1958 to see if we couldn't reclaim this water sufficiently to put it down a well. We were able to percolate the water through the dune sands and water was injected into a well for some six months successfully so that we found out that by the spreading ground type of practice we could get that quality of water, but as I mentioned to the group yesterday, the spreading ground area turned out not to be available so we had to go to the stage we are at now and test rapid sand filter use. This is the filter that you saw yesterday, and the rest of the slides show the clear water that you saw yesterday coming out of the filter.

Now, why is this important? We feel that the Colorado River water supply will not be available for replenishment. Its use will be so predominantly surface use for domestic and industrial purposes by 1968 that we will not have water for a barrier to sea water intrusion unless we have an alternate source, and so it is important that we are able to find a way to make this alternate source.

You folks are familiar with the sewer well law which was amended this past year so that under proper standards of the Water Pollution Control Board and the State Health Department water can be injected through the wells and I'm not going to mention anything

further about reclamation.

Mr. Parkhurst will talk about the plants at Whittier Narrows, but in summary I would like to say that in Southern California we realize that water is a commodity that has to be constantly guarded and saved. This has been demonstrated by the long history of conserving water originating from the local watersheds. It is demonstrated by the present use of water conservation facilities for storing underground large volumes of imported water. It is further demonstrated in the barrier projects which will stem further sea water intrusion, and it is further emphasized by the continued experiments on reclaiming and reusing waste waters.

However, considerable research and development have been necessary in pursuing these aspects of water conservation. Considerable work is yet to be done in order to successfully desilt storm waters for practical spreading, to develop adequate supply lines for delivery of imported water for replenishment in Los Angeles County, to complete the barrier projects and to put them into operation, and to develop and put into use a large-scale spreading and injection of reclaimed water for replenishment.

The groundwater basins are our last waterhole for meeting peak water demands and for emergency storage. They must be protected and maintained in a healthy condition.

Thank you, and there will be copies of essentially the material that has been presented available to you.

(The preceding testimony of Mr. Laverty accompanied a slide presentation.)

(The following is Mr. Laverty's prepared statement.)

"INTRODUCTION: Water Conservation is the corollary of Flood Control; and, wisely, those who initiated the Los Angeles County Flood Control Act in 1915 saw fit to provide the District with the dual responsibility of flood control and water conservation. This discussion will involve only the water conservation portion of the District's responsibilities.

"The need for water conservation and groundwater replenishment stems from the large deficiency of local water sources available to supply the expanding domestic and industrial needs. In another presentation to the Committee, the State Department of Water Resources has given a quantitative evaluation of the large annual overdraft. Although present and future water requirements can not be provided solely from local sources, any conservation accomplished reduces the amount of water which must be imported from other sources.

"The District carries out its water conservation assignment in several ways: much of the mountain and some of the valley runoff is conserved, available imported water from the Colorado River is purchased and used for ground water replenishment, ground water storage is protected by preventing sea-water intrusion, and promising experimental work on waste water reclamation is currently underway.

"CONSERVATION OF LOCAL RUNOFF: Planned ground water replenishment in the Los Angeles area has a lengthy history and in one case predates the turn of the century. At the mouth of the San Antonio Canyon, near the eastern boundary of Los Angeles County, water spreading has been conducted by an association of irrigation companies on a 750-acre area since 1896. Some twenty years later, water spreading was begun on a 500-acre area at the mouth of the

San Gabriel Canyon above Azusa. Many other locations have been used since the 1920's and 1930's; and at the present time, the District owns and operates 22 spreading grounds involving a total area of 1,700 acres and cooperates with other agencies in the operations of 12 additional spreading grounds involving a total area of 1,400 acres. Since 1930, the year the District started its spreading operations, some 314,000 acre-feet of storm waters have been spread in the grounds owned and operated by the District. Thus, on an average, each acre has conserved some $3,700 worth of water based on the conservative value of $20 per acre-foot in the ground, even though the majority of the grounds have been in existence less than 20 years and 15 of these 20 years have been dry.

"Local runoff can be divided into two main sources, namely, Mountain runoff which is largely regulated by dams for later release in controlled quantities, and valley runoff which is essentially uncontrolled. The large urban development in the area has resulted in greater amounts of storm runoff since it has created impervious areas such as streets, parking lots, and roofs of homes. The District has followed a policy of developing off-stream spreading facilities whenever economically feasible to offset percolation lost by paved channels and the other impervious areas. Various facilities are used for conservation purposes. These include unlined streambeds, off-channel spreading basins, and spreading pits. Conservation of local runoff varies considerably as exemplified by the following:

	Water Year 1957-58	(Oct. 1 to Sept. 30) 1958-59
Rainfall - % of normal	167	51
Runoff - % of normal	190	35
Conservation in Spreading Grounds (Acre-feet)	90,742	13,393
Conservation in Unlined Streambeds (Acre-feet)	205,348	25,371
Total Conservation of Local Runoff (Acre-feet)	296,090	38,764

In other words, the ground water replenishment from local runoff in water year 1958-59 was only 13 percent of that in water year 1957-58.

"The District will continue to conserve as much local runoff as is economically practical.

"SPREADING OF IMPORTED WATER: The goal for obtaining imported water for replenishment is to refill the excessive vacant storage of the ground water basins. Obtaining this goal would ensure that the area could meet its peak daily and summer water demands by continued withdrawals from the underground reservoir. It would also ensure a source of water in the event of a natural or man-made catastrophe which could interrupt the supply of imported water, and further it would ensure a source of water in case of delay in completion of facilities for supplemental imported water from northern California (the Feather River Project).

"Much progress has been shown in the imported water program. The program began in 1954 with the purchase of 54,796 acre-feet of untreated Colorado River water. In the past fiscal year (1960-61) about 142,000 acre-feet were purchased and spread; and the total since the program began, amounts to approximately 582,000 acre-feet as of

November 24, 1961. This imported water program is presently financed by two means: (1) an ad valorem tax (5¢ per $100 assessed valuation) against the real property of those who receive special benefit and by a pumping assessment ($5.75 per acre-foot) on water pumpers within the area of replenishment.

"The ad valorem financing is the result of this District's water conservation Zone I, a temporary zone which automatically terminates at the end of five years. Zone I was initially established in January, 1952. It has since been re-established twice, the last time by action of the Los Angeles County Board of Supervisors on September 28, 1961. This last re-establishment will be in effect from July 1, 1962, through June 30, 1967, unless terminated sooner.

"The pumping assessment is made by the Central and West Basin Water Replenishment District, a district formed by election in 1959. Each year it determines average annual overdraft in the basins indicated by its title and sets a pumping assessment accordingly, for the purchase of imported or reclaimed water.

"It is expected that the District's water conservation Zone I will continue to purchase imported water at the rate of some 80,000 acre-feet per year and that the Water Replenishment District will purchase some 170,000 acre-feet per year providing a total of some 250,000 acre-feet of imported water per year for replenishment purposes. This is a maximum figure and is 100,000 acre-feet per year more than is currently available for ground water replenishment due to heavy direct delivery during these dry years.

"BARRIERS AGAINST SEA-WATER INTRUSIONS: Heavy withdrawals from the ground water basins in past years due to the increasing

domestic and industrial demands, coupled with a 17-year period of deficient rainfall, have lowered ground water elevations far below sea level in many coastal areas of Southern California. This has reversed the natural seaward hydraulic gradient, thus causing extensive damage from sea-water intrusion into the coastal ground water basins with resultant large economic losses.

"There is early evidence of sea-water intrusion along the Southern California coast line. It was first noted in the Santa Monica area in the 1920's, in the Manhattan Beach area in the early 1940's, and in the harbor area and eastern Long Beach area during the late 1940's. Sea-water intrusion problems were inevitable with the great pumping overdrafts from ground water. During the ten-year period between 1945 to 1955, the overdraft in the coastal plain area increased from about 70,000 to 200,000 acre-feet per year. During the next 5 years, the annual amount of water pumped from this same area increased from some 300,000 to some 345,000 acre-feet. This increase was due both to the mushrooming growth of the population of the area and the current drought. As a result of these large ground water withdrawals, water levels have dropped below sea level over more than 80% of the 460 square-mile area of the coastal plain. In Vernon, only four miles from the Los Angeles Civic Center, ground water levels are more than 100 feet below sea level. All of the area where ground water levels are below sea level is subject to sea-water intrusion.

"In 1943 the United States Geological Survey's Water Resources Division, Ground Water Branch and the Flood Control District entered into an agreement to investigate the critical situation in

the West Basin area. The District also represented the joint interests of the cities of Inglewood, Redondo Beach, Manhattan Beach, El Segundo, Hawthorne, Culver City, Gardena, Hermosa Beach and the Palos Verdes Estates. This agreement was culminated in 1948 with a report which suggested possibilities for control of saline water. Of the five methods suggested the District chose, as the most promising, that of the maintenance of a fresh water ridge above sea level along the coast. This system requires injection of water through wells in order to get the water below the clay cap which lies underground in the coastal area.

"In 1950 the District undertook experimental well recharging in one well of an abandoned Manhattan Beach well field. At the same time the Division of Water Resources, State of California (now the Department of Water Resources) had been studying sea-water intrusion throughout the State. It was found that the most serious intrusion to date had occurred in the overdrawn West Coast Basin in Los Angeles County and the Central Coastal Basin in Orange County.

"As a result of the experiment at Manhattan Beach and studies of other critical areas by the Division of Water Resources, and through active local interests in the West Basin area, the Legislature in 1951 appropriated $750,000 for field tests of a fresh water barrier to sea-water intrusion. The Division of Water Resources asked the District to undertake the test. By 1954, the project involved the use of about 225 gallons of water per minute in each of nine wells through which the water was placed underground under pressure, thus forming a barrier. At this stage of the project, an area extending 4,500 feet along the coast was protected.

"The project is now operated solely by the District. It presently involves 12 recharge wells, which use a total of about 2,900 gallons of water per minute, and protects an area which extends 1-1/2 miles along the coast. From 1953 to 1961, some 30,000 acre-feet of imported water have been injected into the ground water basin. The current rate of injection is about 4,750 acre-feet per year.

"The barriers are created by injecting water through recharge wells back into the ground thus forming underground pressure dams against sea water. Such injection serves a dual purpose - as a barrier to sea-water intrusion and as a supplement to the inland water supply. It has been determined that about 95% of the injected water travels inland (because of the hydraulic gradient) and that only about 5% is lost to the ocean. This is possible since the fresh and saline waters do not intermingle to any great extent.

"Naturally, problems occur in such a project, most of which involve the actual injection of the water. Periodic rehabilitation of the injection wells is necessary. It has been found that injection rates can be maintained over considerable periods of time by these rehabilitation methods. The water is imported Colorado River water, which has been treated and softened by the Metropolitan Water District. It is the same water used by the various cities for domestic purposes. In addition , the District applies, at the present time, 1.5 ppm of chlorine to prevent growth of slimes around the recharging wells.

"It is planned to expand the barrier project to extend from the Palos Verdes Hills to Playa Del Rey, and expansion from the existing 1-1/2 miles to about 11 miles. After expansion, the barrier

will involve from 60 to 65 recharge wells through which 50,000 to 65,000 acre-feet of water will be injected per year. It is planned to use Colorado River water as long as it is available. The Metropolitan Water District constructed a feeder pipeline costing about $9,000,000 for the purpose of supplying water to the barrier project and to the City of El Segundo.

"It is expected that the additional Barrier Project facilities required will cost $5,200,000, all of which is planned to be financed with funds from this District's water conservation Zone II and the District's regular funds. The project is in the active construction stage at the present time and is expected to be completed by 1965. Zone II was established to assist in financing the construction and operation of the Barrier Project. Zone II funds purchased all the water used for injection until recently when the Central and West Basin Water Replenishment District undertook this obligation. The operation and maintenance will continue to be performed by the Flood Control District. When the project is completed, it is estimated the annual cost for operation and water will be $1,200,000.

"Injection of water through wells is expensive, probably averaging $30 to $35 per acre-foot of water injected including the cost of water at more than $20 per acre-foot. Thus, were it not for its dual function, this would not be a practical means of replenishment of ground water basins on a large scale. Reservoir sites in the coastal area are non-existent. To replace underground storage with above-ground storage facilities would cost from $10,000 to $20,000 per acre-foot of storage. Obviously, a considerable expenditure is warranted to preserve the integrity of the ground water basins.

"A second major area of intrusion is situated in the Alamitos Gap area, which is easterly of the City of Long Beach and straddles the Los Angeles County - Orange County boundary line. The ground water supply of the City of Long Beach, the City of Lakewood, and areas in Orange County is being threatened by intrusion in the Alamitos Gap area. Preliminary planning for a barrier to protect this area of Los Angeles and Orange Counties is complete. As now being planned, the barrier would be about three miles long and would be located in both Los Angeles and Orange Counties. It would require about 35 recharge wells through which approximately 20,000 acre-feet of water per year would be injected into the ground water basin. To supply this and other barriers, the Metropolitan Water District plans to construct a distribution feeder pipeline to the vicinity of the City of Signal Hill. Construction of the facilities is scheduled to begin in fiscal year 1962-63 and will be completed as rapidly as financing permits. The total estimated cost of this project is $3,600,000, of which $1,300,000 is for a four-and-one-half-mile supply pipeline to bring the water from the Metropolitan Water District's feeder pipeline to the vicinity of the Barrier Project, $1,500,000 for a distribution pipeline, recharge wells, and appurtenances which will be located in Los Angeles County, and $800,000 for similar facilities which will be located in Orange County. Financing arrangements have not been completed; however, it is anticipated that a portion of the funds will be derived from the District's water conservation Zone I and another portion may be provided by Orange County water interests.

"A third major area of intrusion is situated in the

Dominguez Gap area which is essentially the Long Beach-Los Angeles Harbor area. Intrusion here represents a hazard to the ground water supply of several large oil refineries, the Dominguez Water Company and other industrial and municipal water pumpers in the area. Preliminary planning is underway on this project, and estimates indicate that the construction cost will be in the order of $2,000,000.

"Thus the cost of the three barrier projects are estimated to be a total of $25,000,000 for construction, including the costs of feeder pipelines constructed by the Metropolitan Water District for replenishment purposes, $1,500,000 annually for water, and $625,000 annually for operation and maintenance.

"WASTE WATER RECLAMATION: That waste water reclamation is feasible has long been apparent. A report pertaining to the potential sewage wasting to the ocean from Los Angeles County indicated that in January, 1958 465 million gallons of sewage per day were wasting to the ocean. Of that amount, 280 million gallons were amenable to reclamation and reuse and 240 million gallons per day were usable for ground water replenishment. Flow of sewage has now increased to about 540 million gallons per day, and a portion of this flow increase probably is also amenable to reclamation and reuse. To understand the role reclaimed water may have in the future, it should be noted that 280 million gallons per day is the equivalent of approximately 300,000 acre-feet per year, which is about 25-30% of the present total water requirements of coastal Los Angeles County. The State Department of Water Resources estimated in its studies for the California Water Plan that the ultimate water requirement in Los Angeles County would be double that of the present. Most of the

water salvaged in Los Angeles County undoubtedly would be for ground water replenishment. By proper planning reclamation sites can be chosen so that cycles of reuse will be controlled, and problems associated with build up of dissolved salts will be avoided.

"In general, there are two ways ground water replenishment may be accomplished. One is by ponding treated waste water on the surface of permeable soils to allow percolation of the water downward through the soil pores to the ground water body. As this water travels in the soils just beneath the ground surface, additional purification occurs. The second method of replenishment is the injection of treated waste water through wells directly into the ground water body. Treated waste water used for the latter purpose must be much more highly purified. Both methods have been tested, and some projects are in operation at the present time.

"In 1948 in the vicinity of the City of Whittier, a test was performed that involved the use of the trickling filter effluent by surface spreading in an area with a relatively tight soil condition. In 1949, in the vicinity of the City of Azusa, another test was performed, again involving a trickling filter effluent with surface spreading but this time in an area with a loose or gravelly soil condition. These small-scale tests indicated that surface spreading would provide an economic and safe means of using reclaimed waste water for ground water replenishment.

"It was found that alternate wetting and drying of the spreading areas provided an economical means of handling a fairly well stabilized effluent and that percolation through seven feet of unsaturated sand and gravel was sufficient to remove bacterial contamination.

"The increasing demand on the Colorado River water supply and the need for full capacity of distribution facilities for delivery of water for surface use will begin to limit supplies available for the sea-water intrusion barrier projects by about 1968. Yet, the barrier projects must be operated continuously to protect the ground water basin. This has led to tests for purifying the water which wastes into the ocean through the City of Los Angeles' Hyperion Treatment Plant in El Segundo. Tests were performed during the period 1955 to 1958 in the vicinity of the Hyperion Plant with the goal of determining if waste water could be purified sufficiently to inject through a well into a ground water body. Considerable information was obtained on quality, quality variations, and treatment techniques. Though the tests were conducted when the plant effluent was of a lower quality than at present, it was possible to percolate the treated water through several feet of dune sand and develop a water purified enough to be injected through a recharge well at rates comparable with Colorado River water.

"Supplemental tests are now underway in the vicinity of the Hyperion Treatment Plant with the specific aim of determining if large-scale, rapid-sand filtration or diatomaceous earth filtration will be a satisfactory purification treatment for use in injection wells and be practical from the standpoint of operational techniques, consistency of water quality and cost. If these tests prove successful, then reclaimed waste water from the Hyperion Treatment Plant could be a supplemental supply of water for the West Coast Basin Barrier Project and perhaps for some of the local industries.

"The test involves the further treatment of a standard rate activated sludge effluent which is received from the Hyperion

Plant (this is the stage of treatment which is the normal product of most complete sewage treatment plants). The facilities are being installed to pass plant effluent through a rapid-sand filter and inject it into a test recharge well. Provision is being made to chlorinate the water at any of several locations that might be desirable and to provide additional minor variations and treatment if it should be necessary. The amount of water to be treated and injected is relatively large so that test results should be typical of those which would be expected fro m a large-scale purification plant.

"One of the conclusions of the 1955-58 tests was the need for revision of the so-called sewer well law (Section 4458 of the State's Health and Safety Code), which prevented the discharge of any water of sewage origin into a well which reached ground water. Amendments to this section of the code, which will allow such discharge following thorough purification, were enacted by the legislature in the 1961 session. There is now provision for control of such discharge by the Regional Water Pollution Control Boards and by the State Department of Public Health.

"The District is participating in another waste water reclamation project in the vicinity of the Whittier Narrows Dam. This particular project will be discussed by Mr. Parkhurst later in the hearing.

"SUMMARY: In Southern California, we realize that water is a commodity that has to be constantly guarded and saved. This is demonstrated by the long history of conserving water originating from the local water sheds. It is demonstrated by the present use of water conservation facilities for storing underground large volumes

of imported water. It is demonstrated in the barrier projects which will stem further sea-water intrusion, and it is further emphasized by the continued experiments on reclaiming and reusing waste waters.

"Considerable research and development have been necessary in pursuing these aspects of water conservation. Considerable work is yet to be done in order to successfully desilt storm waters for practical spreading, to develop adequate supply lines for delivery of imported water for replenishment, to complete the barrier projects and put them into operation, and to develop and put into use the large-scale spreading and injection of reclaimed water for replenishment.

"The ground water basins are our last water hole for meeting peak water demands and for emergency storage. They must be protected and maintained in a healthy condition."

MR. BUTLER: Thank you, Mr. Laverty. Now, in Los Angeles County we also have a number of county sanitation districts. They serve most of the territory in the coastal plain outside of the City of Los Angeles and some of it is within the City of Los Angeles. This organization is the one which is building this water reclamation plant which you saw yesterday. The chief engineer of this organization is Mr. John Parkhurst and he will talk to you at this time.

MR. PARKHURST: Thank you, Mr. Butler. Mr. Chairman and Members of the Committee, I would like to preface my remarks with one simple statement and that is that the figures, overall water figures that I will give include all of Los Angeles County, including the City of Los Angeles Sewage System. However, the program about which

I will speak is only that of the sanitation districts which I represent.

Waste water reclamation in the Los Angeles Metropolitan Area is now supplementing and can further supplement the natural and imported supply of fresh water. Reclaimed water is limited in both quality and quantity, but is still a significant potential source of expansion of the vital basic water supply.

Continued growth of the Los Angeles Metropolitan Area is dependent upon the continued expansion of the water supply -- a fact that has been recognized in the past through the major engineering achievements of bringing water from the Owens River and the Colorado River and which most recently has been recognized through the implementation of the California Water Plan to bring Sacramento-San Joaquin Delta water to Southern California. However, even those programs may not prevent a serious water shortage before the estimated date of arrival of Sacramento-San Joaquin Delta water in 1972. With ground water basins severely overdrawn, a factor aggravated by the past three severely dry years of a seventeen-year drought, and with the extensive intrusion of salt waters along the coast, a potentially critical situation may be partially alleviated by the extensive reclamation of our municipal and industrial waste waters.

Last year, approximately 1,200,000 acre-feet of water from all sources was produced and used in the coastal plain of Los Angeles County. Nearly 50% of that water (580,000 acre-feet) found its way to the sewerage systems of the County Sanitation Districts and the City of Los Angeles and thence to the Pacific Ocean. Estimates made in 1958 indicate that over 55% of the wasted flow (320,000 acre-feet)

was of a quality and so located as to be amenable to water reclamation and reuse. In its simplest terms, therefore, a comprehensive reclamation program could increase the available supply of water for basin recharge and direct industrial use by approximately 25%. In 1955 the State Water Resources Board estimated the ultimate water requirements of coastal Los Angeles County to approach two million acre-feet per year. Sacramento-San Joaq uin Delta water will some day provide the bulk of this but waste water reclamation can continue to provide a significant portion of the total demand and at a reasonable cost for production.

In considering water reclamation from waste waters, it is important to note that the salt content from reclaimed waste waters cannot be appreciably above the salt content of waters in the underground basins without leading to a gradual deterioration of the ground water quality. In order to maintain the salt balance of the underground waters, it is estimated that approximately half of the community's sewage flow must waste to the ocean and serve the vital function of carrying the excessive salts away.

To outline the basic concept of water reclamation, it is first necessary to explain the difference between sewage treatment and water reclamation.

Sewage treatment defines the responsibility of a community to safely receive, convey, treat and dispose of all water-borne wastes of the community regardless of their quantity, quality or timing.

Water reclamation is a bonus to the community, wherein the waste-conveying medium, water, is conserved for reuse by

separating the undesirable wastes from the water carrier at such strategic times and places as the system will allow.

However, utilization of the sewage as a raw water supply does not impart to the reclamation plant the responsibility for treatment or disposal of the waste under all conditions. If at any time the sewage does not constitute a satisfactory raw water supply due to quality deterioration, or if the treatment process of the reclamation plant is so disturbed as to fail to produce a water of satisfactory quality, the reclamation plant can be operated at reduced capacity or cease to operate entirely and all the community waste must still be handled by the sewerage system.

In fact, when a waste water reclamation plant is operating at its best it will also be generating wastes which can be most economically disposed of by discharging them to the sewerage system for treatment. It is therefore the existence of a vast complex of trunk sewers in Los Angeles County which makes water reclamation most practical, dependable, and economical.

The only sewage that can be economically reclaimed is that of predominantly residential origin. The major residential areas contributing to the Sanitation Districts' trunk sewer system are located in the outlying reaches such as the San Gabriel Valley or Lakewood-Long Beach area, whereas, two-thirds of the industry of Los Angeles County is located in the central south coastal area of the Sanitation Districts. The types of chemical pollutants and the quantity of brines and other strong wastes originating in the industrial areas are sufficient to render sewage flows in the system chemically unsuitable for reuse by spreading to the ground waters.

It is therefore important from a water reclamation standpoint to intercept and treat domestic wastes around the periphery of the trunk sewer system prior to pollution by industrial wastes.

After industrial pollutants have raised the dissolved solids level of waste waters above accepted limits, there is no economical method of making the water suitable for spreading. Present estimates for the reclamation of brackish waters requiring demineralization indicate the cost would be on the order of twenty times the cost of reclaiming a domestic waste water. In addition, flows with high dissolved solids content usually are located near the ocean and would require extensive pumping and distribution systems to convey them to a location for spreading. However, there are some industries which could utilize reclaimed waters high in dissolved solids content without desalting if they were available in the right places.

In 1948, the Los Angeles County Board of Supervisors directed a Board of Engineers composed of C. E. Arnold, H. E. Hedger, and A. M. Rawn to investigate the possibilities for reclaiming water from sewage and industrial wastes in Los Angeles County. The comprehensive report submitted by the Board of Engineers in April, 1949, outlined the basic facts of waste water reclamation which are still pertinent today. The report also included comprehensive data on the technical aspects of reclamation and presented a cost analysis for a number of specific proposals. In addition, it outlined the legal problems which needed correction by action of the State Legislature in modifying the laws controlling the activities of Sanitation Districts, and other concerned agencies.

By 1958 major headway had been made on the legal and

legislative fronts and a review of the water reclamation program was ordered by the Board of Supervisors. A 1958 report prepared under the direction of H. E. Hedger and A. M. Rawn supported the general findings of the 1949 report and in addition, stressed the increased importance of reclaimed waste waters as the only feasible method of expanding the available water supply of the area prior to the delivery of Sacramento-San Joaquin Delta water. In addition, the report specifically outlined the proposal for a demonstration ten million gallon per day reclamation plant at Whittier Narrows including a unique cooperative arrangement whereby; the County of Los Angeles would provide the initial financing; the Santiation Districts would design the plant, supervise construction and operate the plant; the Flood Control District would receive and spread the treated waters; and the Central Basin Municipal Water District would purchase the water at such a price as to pay back the costs of the project in a thirty-year period.

I might digress just a moment to indicate to you that the contract was actually signed with the Central and West Basin Water Replenishment District.

The only remaining legal obstacle was the fact that the County still did not have the power to finance such a project. However, in January, 1959, Assembly Bill No. 88 was passed giving to the county broad powers to participate in and to finance water reclamation projects. In 1960, the Board of Supervisors budgeted the $1,700,000 necessary for the project and design work began by the Sanitation Districts immediately thereafter. On February 1, 1961, the four-party agreement was officially signed by all members. Design was completed by June, 1961, and bids were received on July 12,

1961, with the principal contract awarded for approximately $1,370,000. Costs for effluent lines, landscaping, fencing, and engineering will bring the total cost of the project very near the estimated $1,700,000.

In accordance with the terms of the agreement, the Central and West Basin Water Replenishment District will purchase all of the water delivered for spreading at a price equivalent to the price of untreated Metropolitan Water District water and the Sanitation Districts will contribute $1.00 per acre-foot as the stipulated savings to the District for removing the flow from the system. The current sale price of $12.75 per acre-foot will be adjusted at the end of each three-year period to conform with any changes in the Metropolitan Water District price. Of the income from sale the Sanitation Districts will pay to the county $6.00 per acre-foot and use the remainder for the operation and maintenance of the plant, estimated at $7.00 per acre-foot. Due to the experimental nature of the plant, the county has provided the funds at no interest. If receipts are greater than anticipated or required for operation, repayment to the county will be made at a higher rate. The estimated spreading cost of $2.50 per acre-foot will be supplied under the general budget of the County Flood Control District.

With this background on the events leading to the construction of the Whittier Narrows Water Reclamation Plant it is possible to discuss the plant itself and its anticipated role in the county's water reclamation program.

The Whittier Narrows Water Reclamation Plant is being constructed to demonstrate that such a plant can economically reclaim

from sewage water of such quality that it can be returned to the underground without fear of degrading the over-all water quality of the aquifers. Operation of the plant will supply valuable data pertaining to the cost per unit of water returned to the underground, the degree of treatment required to produce waters which can be satisfactorily percolated through the spreading basins to the underground aquifer, and the fate of the ABS detergents during and after treatment. Operational experience obtained from the demonstration plant will be available for guidance and planning of water reclamation on a more comprehensive scale.

The site on which the water reclamation plant is being constructed is located adjacent to a 60-inch diameter outfall trunk sewer which carries principally domestic sewage originating in the San Gabriel Valley. The location is west of Rosemead Boulevard and north of San Gabriel Boulevard in the reservoir area of the Whittier Narrows Dam, thus affording isolation from residential development. However, the proximity of the two major highways will make it readily visible to vehicular traffic. Planting of trees and shrubs around the structures and plant facilities is planned to conform with the general landscape program within the recreational area of Whittier Narrows. Since the site is in the upper end of the reservoir basin, operation may be curtailed during major storms. During these periods, depending upon the depth of water impounded, the plant may be placed on a standby basis as a portion or all of the plant grounds may be subject to submersion by the impounded waters. Inundation of the process tanks by flood waters is anticipated during the 100-year storm, but the control building with the major mechanical and

electrical equipment will be protected from the maximum storm.

Reclaimed waters from the Plant will be delivered to the Los Angeles County Flood Control District for spreading. The Rio Hondo and San Gabriel spreading grounds which are to be used are located approximately three miles downstream from the reclamation plant site and the water will gravitate to the spreading basins. During normal operations, the reclaimed waters will be mingled with natural rising waters at the Whittier Narrows, affording considerable dilution before reaching the spreading basins.

The water reclamation plant is being designed as a standard rate activated sludge plant. However, since this is to be a demonstration plant, provisions are being made in the design to allow operation using step aeration, contact stabilization, or variations of these processes. Although the plant is being designed for a normal capacity of 10,000 acre-feet per year, space is available and the location suitable to increase the plant to 100,000 acre-feet per year capacity in the future, if desired.

The present average daily flow through the outfall trunk sewer is approximately 55,000 acre-feet per year. Sewage will be pumped at a constant rate of 10,000 acre-feet per year from the outfall trunk sewer into the primary sedimentation tanks, then will gravitate through the remainder of the plant and into the effluent channels leading to the spreading basins. There will be no bar screens, screenings grinders, or degritting tanks ahead of the plant. All skimmings along with sludge from the primary sedimentation tanks together with the excess activated sludge will be returned to the outfall trunk sewer at a point below the plant. This will eliminate

the necessity for sludge digestion, drying, and disposal facilities along with the accompanying odor problems and cost of this operation. Odors will further be eliminated by the covering of the primary sedimentation tanks and withdrawal of air from under the covers to supply blowers for the aeration system. The final effluent from the plant will be chlorinated before it is discharged into the effluent channels leading to the spreading basins.

Sewage to be treated at the Whittier Narrows Water Reclamation Plant will probably contain approximately 650 ppm. of dissolved solids and total solids of approximately 900 ppm. Five day BOD of the sewage will average approximately 250 ppm. The ABS detergent content of the raw sewage will average approximately 9 ppm.

The State of California Regional Water Pollution Control Board No. 4, Los Angeles Region, by resolution, has stipulated the limits that the effluent quality shall at no time exceed. The treatment plant design has taken into consideration all the chemical requirements (which are included in Appendix A), and it is felt that the quality of the effluent will fully comply. These are shown on Appendix A. (Appendices are on file in the Committee office.)

The Whittier Narrows Water Reclamation Plant is scheduled to commence operations in the summer of 1962. It is designed and equipped to permit operation with a single attendant on duty eight hours per day, 7 days per week. Since no human habitation is allowed by the U. S. Army Corps of Engineers in the reservoir area, a resident operator will live a short distance from the plant outside the restricted area. The operator's residence will be considered an integral part of the plant and will be equipped with alarms which will

immediately signal power failure at the plant. Remote control instrumentation panels will continuously indicate and record the function of the critical equipment at the plant such as blowers, chlorination, other equipment, and operation of the pumps.

Normal maintenance of the equipment will be performed by the resident operator. Repairs to the equipment, piping, and other heavy work will be undertaken by a special maintenance crew from the Districts' San Gabriel Valley Maintenance Yard, as required.

Since this is a demonstration plant, extensive tests will be conducted not only by the staff of the Sanitation Districts and Flood Control District, but undoubtedly by various regulatory agencies including the Regional Water Pollution Control Board, County Health Department, State Health Department, and State Water Pollution Control Board. Test wells will be so located as to permit sampling both above and below the percolation basins in order to study the effect of the reclaimed water on the underground aquifers.

With the commencement of the design of the Whittier Narrows Demonstration Plant in 1960, the basic recommendations in the 1958 Rawn-Hedger report were implemented. But in spite of the significance the Whittier Narrows plant was to have in the entire field of water reclamation, its capacity of 10,000 acre-feet per year represented only a tenth of the quantity estimated as reclaimable from the Sanitation Districts' entire system. Therefore, in December, 1960, the Board of Directors of the Sanitation Districts authorized the Chief Engineer to proceed with a further survey to augment the 1958 report and to cooperate with other interested public agencies in the preparation of the report. Such a study with the objective of

making additional specific recommendations for water reclamation plants is currently in progress. In October of this year the County Board of Supervisors directed a cooperative study be prepared between the Sanitation Districts, Flood Control Districts, Chief Administrative Officer and any interested cities to obtain the complete picture of the water reclamation potential in the county. The county-wide report will incorporate the efforts of the several agencies and bring together their plans and proposals. The contribution of the Sanitation Districts will be a result of the survey and study now in preparation.

The general study will involve a literature survey, an analysis of the sewerage system with respect to origin of wastes, and a comprehensive sampling program to establish sewage quality. Such information will provide the basis for plant designs and cost estimates. Though present proposals can only be considered tentative and subject to the future findings of the study, the current proposals for reclaiming 100,000 acre-feet per year of waste water within the Sanitation Districts can be summarized as follows:

The Whittier Narrows Water Reclamation Plant can easily be expanded to 50,000 acre-feet capacity from the flow now passing through the site. In addition, it is physically possible to conduct another 50,000 acre-feet per year to the Whittier Narrows site from the San Fernando Valley. I might say that this flow from the San Fernando Valley is not included in the figure of 100,000 acre-feet per year which is the potential in the Sanitation Districts. The Flood Control District has more than ample spreading basin capacity for this amount of flow.

The Districts now operate three small water reclamation plants in the upper San Gabriel Valley; one in Pomona of 4000 acre-feet capacity and two in Azusa with a combined capacity of 1000 acre-feet per year. Each of the plants could be expanded to two or three times its present capacity. There are also several other sites where small plants could be built in the San Gabriel Valley. While such plants do return water higher on the alluvial slope, the unit cost of such water will be higher than if the same water were treated at Whittier Narrows. As yet, there is no agency in the upper San Gabriel Valley prepared to purchase such water on a contract basis.

Other projects under consideration would involve the spreading of reclaimed waters in abandoned gravel pits along the north side of the Palos Verdes Hills and the irrigation of parks and golf courses in the Inglewood area. There are also possibilities for providing water for recharge wells of the Flood Control District salt water barrier projects, subject to the findings of the Hyperion studies.

The capital cost for the combined potential reclamation capacity of 100,000 acre-feet per year is estimated to approach twenty million dollars. District funds are not available to provide the total financing but, through the previously demonstrated capacity for cooperation between interested agencies, adequate financing can probably be achieved. A more acute problem is that of land acquisition in areas of the county where land usage has already eliminated many possible sites for plants and spreading facilities and where remaining possibilities are rapidly disappearing.

In summary, the Sanitation Districts are convinced of the importance of reclamation of waste waters as a means of supplementing

available water supplies. There is every expectation that the Whittier Narrows Plant will not only demonstrate this feasibility successfully to the public, but provide the impetus for an expanded reclamation program. To that end the Districts are now preparing a master plan for the orderly development of reclamation facilities.

I think you. It has been a pleasure to appear before you.

CHAIRMAN PORTER: Thank you. If I may ask a question, Mr. Parkhurst, I think it was on page 10 -- somebody from the tour yesterday explained to me what ABS means in referring to detergents, but I notice towards the bottom, the second from the bottom paragraph you say "five-day BOD". What does "BOD" mean?

MR. PARKHURST: That is the term that is used to express the organic content of the sewage. It is the biochemical oxygen demand.

CHAIRMAN PORTER: Just a minute. I mean somebody will ask me and I'm supposed to know -- biochemical oxygen --

MR. PARKHURST: Demand. It is usually expressed as a five-day figure.

CHAIRMAN PORTER: And your ABS again is?

MR. PARKHURST: Alkyl benzene sulfonate detergent.

CHAIRMAN PORTER: Thank you very much.

MR. BUTLER: Thank you, Mr. Parkhurst. Mr. Chairman, the Los Angeles City Department of Water and Power over a period of many years has had to deal with many of the problems which we have been talking to you about yesterday and today. The assistant chief engineer and general manager of the department, Mr. Max Socha also heads up the water works part of this department and he will now talk to you.

CHAIRMAN PORTER: Before Mr. Socha takes over, several people are going over to inform the desk that they are going to get out later in the day.

MR. SOCHA: Thank you, Mr. Butler. Mr. Chairman, the City of Los Angeles, through its Department of Water and Power, is pleased to be able to formally present to the Assembly Interim Committee on Water data regarding the ground water conditions in the local areas from which it obtains its water supply. The City is fully aware of the past and present demands being made on the ground water basins in the State, and especially so on the basins in this immediate vicinity. Some of the data presented herein have been presented informally to the committee. Attached are two sketches, Exhibits 'A' and 'B'. Exhibit 'A' depicts the general location of the three ground water basins from which the City extracts water. Exhibit 'B' depicts in some detail various features in the San Fernando Valley.

HISTORICAL SKETCH: The City of Los Angeles, from a pueblo of 28 square miles and 44 people in 1781, has now grown, in 1961, to a metropolis covering 458 square miles and a population over 2,500,000. The City has always been water conscious. It has zealously protected its "Pueblo Rights" on the Los Angeles River. Due to the farsightedness of its early pioneers, Los Angeles has gone north to the Owens Valley and Mono Basin areas for water, via the Los Angeles Aqueduct. It was the prime mover in bringing Colorado River water to the area through the Metropolitan Water District of Southern California.

WATER RIGHTS PROBLEMS: At the founding of the Pueblo the Spanish Government provided a water supply for the community. The

supply consisted of a grant of right to the waters of the Los Angeles River from its sources to the southern boundary of the Pueblo. The City of Los Angeles, as successor to the Pueblo, claims this right and has successfully defended it in court. The City is again litigating its right. Testimony with reference to the current litigation has been presented to your committee by representatives of other governmental agencies.

SAN FERNANDO VALLEY

VALUABLE SUPPLY SOURCE: In the early days the Los Angeles River furnished a water supply from surface sources. The River continues to furnish water to the City; however, in more recent times the supply is taken mainly from the ground water body by means of wells and galleries located in the San Fernanco Valley.

Exhibit 'B' shows the San Fernando Valley to be surrounded by mountains and hills. Ingress and egress is gained through various passes or along the course of the Los Angeles River, through the gap known as the Narrows in the vicinity of the City of Glendale. The valley can be considered to be a bowl of rock filled with detritus and erosion material from the surrounding mountains which form a basin with only one outlet and that is the Los Angeles River in the narrow part of the valley in the vicinity of Glendale.

The valley's soil mantle is generally considered to be divided into two classes. The soil east of Sepulveda Boulevard contains sands and gravels, lending themselves to good water percolation. That is because the hills in the east end of the valley are composed of sandstone and granitic powders which make the erosion material from that source sand and gravel. The Tujunga and Pacoima washes

traverse the area as they contribute to the Los Angeles River - situated along the southern edge of the valley. The soil west of Sepulveda Boulevard contains more clay and is not as conducive to percolation.

The value of the San Fernando Valley as a ground water storage basin is twofold. First, it provides a large quantity of good water to be used as a part of our supply. During the fiscal year 1960-61 water production by the City of Los Angeles from the valley was approximately 91,500 acre-feet. That has been consistent since about the year 1950 when we reached the maximum production in this area. The heaviest extractions were during the summer seasonal peaks. During the peak month (July 1960) a total of 12,896 acre-feet was produced. The lowest month during the year (December 1960) was 1,040 acre-feet. This total production represented about 85% of the City's local ground water production, or 19% of the total water demand. The water extracted is considered to be composed of native and imported water that had percolated to the ground water basin.

In addition to the City's production for that year it is estimated that the three cities of Glendale, Burbank and San Fernando extracted a total of approximately 45,000 acre-feet.

Secondly, the valley provides storage for replenishment resulting from years of above normal supply, either from import or from local rainfall and mountain runoff. It has been estimated that the recharge to ground water has varied up to a maximum of over 280,000 acre-feet for the water year 1940-41, which was one of the last of our heavy water years. The underground reservoir has thus provided storage for large quantities of recharge

occurring during the periods of surplus supply. During the years of deficient rainfall the ground water storage, placed in years of excess, has been drawn upon. The urban and industrial expansion in the valley, starting in the 1940's, has made much of the former natural recharge area impervious, thus reducing the natural replenishment. The farm fields have been subdivided, houses and appurtenances built, streets paved, storm drains and sewers constructed - all of which has reduced the natural percolation area.

In 1953 the City completed an investigation of the available water supply of the Upper Basin of Los Angeles River. That investigation indicated that the estimated extractions by the City in 1955 would be equal to the safe yield. Based on this information, an action for injunction was brought by the City of Los Angeles against other pumpers in the valley. This is the suit in which the State Water Rights Board is now acting as Referee and referred to in earlier testimony. The Board's proposed "Draft of Report of Referee," dated June 20, 1961, shows that the quantity of water in storage within the alluvium in the valley decreased by more than a half million acre-feet between 1944, the year of the highest ground water storage of record, and 1958, the then lowest of record. Since then, of course, we have had the continuation of the drought period. This reservoir under proper basin management can again be refilled in preparation for the next dry cycle. (Our previous informal statement lists 1941, whereas it should be 1944.) It is significant that during the year 1957-58, when the rainfall was 163 per cent of the 85-year normal, the ground water storage continued to decrease.

Prior to 1915 all recharge was from native water.

Introduction of imported water from Owens River, with terminal storage at our Van Norman lakes, in 1915 provided for the irrigation of agricultural lands and today provides for much of the water supply of the San Fernando Valley in addition to other portions of the City. (See Exhibit 'B'.)

As the valley grew in population the formerly uncontrolled creek channels were confined and improved. Prior to that, during times of flood the native waters spread over large areas of the alluvium, thereby allowing for much percolation to the ground water body. Prior to the channel improvement, partial control over flood quantities was provided by construction of upstream dams and reservoirs. The Tujunga Wash, the largest tributary of the Los Angeles River, had been the channel that contributed much to percolation. With its improvement and the construction of Hanson Flood Control Basin, approximately 5 miles below the mouth of Tujunga Canyon, it became more apparent that provision must be made for additional off-channel spreading grounds. Consequently the Los Angeles County Flood Control and Conservation District constructed its Hanson Spreading Grounds immediately downstream from Hanson Dam. Only native water has been spread at this site. Flood waters from Pacoima Creek have also been spread by the Flood Control District at its Pacoima spreading grounds. The combined capacity of these spreading grounds is insufficient to spread enough water to equal native conditions.

For the spreading of additional quantities of native water, the City of Los Angeles has maintained, since 1937, a small combined spreading ground and gallery on the Tujunga Wash upstream from Hanson Dam, designated as the Tujunga Gallery. The captured water is put

directly into the distribution mains in the area. About 2,000 acre-feet annually has been thus diverted. Unfortunately this gallery is floating in the sand and it is not down to bed-rock so we are actually not taking water out of an underground basin but more or less out of an underground stream, and if the flow from the Tujunga Dam is decreased to a certain percent the gallery is left high and dry. However, the water is not lost because it is recovered lower down in the valley if we miss it at this point. The principal purpose of this gallery is to intercept the water and recapture it about two years in advance of what it would be if we let it go down to the wells lower in the valley. It is a matter of saving time and getting water back.

In addition to that operation, a larger facility, known as the Headworks Spreading Grounds and water collecting galleries, is operated along the Los Angeles River, near Griffith Park. The galleries were originally constructed to collect waters percolating in the natural river bed and were directly under the river. When the river was improved and its alignment changed by concrete lining and widening in 1939, diversion gates were provided and a 35-acre area, adjacent to the channel, is now used for spreading purposes. This area is directly over the original galleries. The water spread consists of the final phases of storm runoff, upstream natural or pumped ground water discharge, and operational releases of Owens River water. In other words, we try to use this as low-flow off-season spreading rather than the recapture of the flood waters from the major winter storms. This gallery is built in the natural bed-rock underneath there and where we spread water over the basin it sinks down through the sand and is collected through these upside

down wells and galleries and flows out and then is pumped into the conduits that take it into the distribution system in the reservoir.

In 1930 the City acquired 183 acres of land adjacent to the Central Branch of the Tujunga Wash for water spreading purposes. These spreading grounds were used for the spreading of surplus imported Owens River water. During the 12 years (1931-32 to 1942-43, inclusive) a total of approximately 170,000 acre-feet was spread. The following tabulation shows the annual quantities.

HYDROGRAPHIC YEAR	ACRE-FEET
1931-32	20,337
1932-33	26,873
1933-34	20,855
1934-35	24,774
1935-36	19,309
1936-37	8,736
1937-38	5,731
1938-39	12,259
1939-40	3,022
1940-41	3,446
1941-42	11,290
1942-43	12,130

The data above indicate that if surplus Owens River water again becomes available, the spreading grounds can be used to good advantage.

The City has made arrangement to spread native water from the Tujunga in excess of the capacity of the Flood Control District's grounds upstream. That is, the Flood Control will take the primary water from the mountain runoff that is available for spreading into their beds and if there is more water available and it is rejected by their bed because of lack of percolation capacity, then we will recapture it downstream and put it in our spreading grounds so these two spreading grounds will be operated in conjunction with each other,.

one to supplement the other in the case of mountain runoff. The spreading grounds cannot presently be used to full advantage, as the State is now constructing the Golden State Freeway in the vicinity and will be constructing the Hollywood Freeway Extension across portions of the area. When the exact land and material requirements are known, the City's spreading grounds will be reconstructed for the spreading of available water.

One of the primary rights and obligations of the City is the protection and control of the ground water supply of its citizens. The basin underlying the San Fernando Valley is one of its most important water assets and has been used as a source of supply for over a century. The City's primary control in this regard includes extractions, recharge, sanitary protection, etc. The above discussion has highlighted the City's past activities in the basin and shows its future intent. Basins can be adequately managed by judicious water extraction, replenishment and by use of supplemental imported water when needed.

The engineers of the Department of Water and Power have for many years regarded the San Fernando Valley as an excellent terminal storage reservoir capable of storing over a half-million acre-feet above the present levels of the underground water table.

PRODUCTION FROM THE COASTAL PLAIN

It has previously been indicated that approximately 85% of the City's local ground water production comes from the San Fernando Valley. The balance is pumped from the West Coast and Central Basins of the Los Angeles County Coastal Plain in the southern portion of the city.

The 1960-61 production from both of these coastal basins was approximately 16,000 acre-feet. The Central Basin extraction was approximately 15,000 acre-feet and was from plants located across the City from Slauson Avenue on the north to 120th Street on the south. The West Coast Basin extraction was from the Lomita Well Plant in the Harbor area. The production from that area is limited to a maximum of 1,310 acre-feet annually by a recent judgment of the Los Angeles County Superior Court in the case of the West Basin adjudication.

The City has imported water to the Los Angeles County Coastal Plain since 1914. The quantity of those imports has increased until in 1960 a total of approximately 250,000 acre-feet was imported. Use of this imported water has greatly reduced the quantity of local ground water that the City would have been required to pump. I would say in addition to that by the use of imported water we did our part in reducing the amount of overdraft of the basin because we not only did not take water out of the ground to an appreciable extent, but there was certain contribution to the groundwater by the importation of Owens River water into this area.

In addition, the City has purchased numerous private water companies in that area. In most cases the acquired wells have been shut down and imported water substituted. These two policies have reduced the City's draft on the two ground water basins.

The tremendous growth of the Coastal Plain, especially outside the City, has put a heavy burden on the ground water of those basins. This has been partially alleviated by recent use of imported Colorado River water from the Metropolitan Water District.

It is a well established fact that overdraft has existed for some time. We have talked about that at considerable length today through other speakers. With the basin overdrawn, it seems apparent that efforts must be made to reduce the overdraft and the City of Los Angeles certainly subscribes to and will participate to the extent it is reasonable for the portions of the City that lie within those basins.

The efforts made by both the County Flood Control District and the Central and West Basin Water Replenishment District have partially corrected the ground water conditions in the immediate vicinity of their operations.

The City would like to see these basins managed so that they will again become important reservoirs for emergency use for summer peaks and dry year conditions without overdraft and the problems of salt water intrusion.

SUMMARY: In summary, the City of Los Angeles has always been in favor of good basin management, thereby protecting a very vital resource. The City of Los Angeles has done much to protect the two basins from which it extracts water -- by importing water, by spreading the surplus import, by encouraging the conservation of native water.

Let up hope that the lesson learned during the almost too late underground replenishment by the use of imported water from the Colorado River will condition all of Southern California to the full use of Feather River water during the early surplus years of operation to rebuild our underground reservoir to the point that during dry periods we can draw on planned storage and not continued overdraft.

Thank you.

CHAIRMAN PORTER: May I have a question again? Your paper is extremely well done, but I notice that -- I have the impression that you speak throughout in terms of available storage space in a number of places.

MR. SOCHA: Yes.

CHAIRMAN PORTER: You say in effect here is where we could put the water and in another case here is where some water could be stored and you speak for the most part in terms of storage space. Now, I have a feeling that other papers have without exception spoken in terms of how much acre-footage they have stored and they have talked about a replenishment program. Do you have any figures which show for Los Angeles City in terms of their water usage for local needs, which I think you have described by using a different term, native needs, you call it I think.

MR. SOCHA: I stated that the annual extractions from your underground basin, San Fernando Valley, was approximately 90,000 acre-feet per year which corresponds to our needs from that source with a managed basin properly managed within a safe yield.

CHAIRMAN PORTER: Do you have figures that escape me -- I was reading every line I thought, which show the amount that you have spread or put into the underground?

MR. SOCHA: That is correct. There is a tabulation in the report.

CHAIRMAN PORTER: All right, I'll study that.

MR. SOCHA: I didn't read every figure in the tabulation. I didn't want to bore you. I gave you the maximum and minimum on

CHAIRMAN PORTER: Fine. Now then,when you use the term in here "native percolation", I believe, it means where there are streambeds or river courses, when you have your calculations of how much water has percolated or settled and gone in?

MR. SOCHA: Yes.

CHAIRMAN PORTER: Now, perhaps upon study of the tables there I'll have a couple of my questions answered.

MR. SOCHA: Just to clarify what I think is bothering you a bit, we have had sort of a multi-program. We have spread in cooperation with Flood Control what we call mountain runoff water. We have means of doing that and collecting it. We have also in the past when we had surplus Owens River water, we have spread that. We also intend, although it probably wasn't clear in here, we intend in the future and we expect to spread imported water from the north when it is available, probably in reference to spreading Colorado River water for two reasons, one, the water we can get from the Metropolitan from the Feather River source would be gravity water whereas the water we get in the valley because of the way their system is designed, would be a pump supply, so for that reason and maybe some other reasons of quality, we would probably prefer to spread Feather River water but we do intend to have a spreading program. One of the things though we have to have before we can go ahead with a purchase program of purchasing water and spreading it is the control and management of the basin because the city contends it has this basin. There are other cities that are using this basin and until we do have full control and management, we couldn't with any reason go ahead and purchase

water from the imported source other than our own and put it into the ground for the benefit of these other people who we claim are poaching upon the supply. So the first thing we have to settle for the future is the litigation on the San Fernando Valley case and then when we have control of that basin we feel we can go ahead on an orderly program of spreading imported water in the future.

CHAIRMAN PORTER: If I am correct in assuming this, in Orange County the six cities I believe that Howard Crooke referred to have cooperated in a basin-wide spreading program. You mean then that the larger number of cities in and around Los Angeles City that might be drawing from the same basin need to be put in a position either by agreement or by litigation first before you can reasonably be expected to spread water there?

MR. SOCHA: I think I mentioned we have two sources of underground water. One is the Coastal Plain and the other is the San Fernando Valley. In the Coastal Plain we exist there with correlative rights, the same as any one else. We claim no prior rights, no pueblo rights whatsoever, so we go into a replenishment district and we bear our proportional share and take our proportional benefits. In the San Fernando Valley we have a different situation. There is a difference in the interpretation there. We have the pueblo right and it is a duty to maintain that and until such time as that has been definitely settled legally, we cannot go ahead with a program of purchasing imported water which may not be to our benefit but to the benefit of some other cities. There is a difference between the two.

CHAIRMAN PORTER: One last short question, has the City of

Los Angeles purchased any water from the Metropolitan Water District for spreading?

MR. SOCHA: No. We haven't purchased water for spreading. We purchase water for direct use and for reservoir replenishment. We buy water from the Metropolitan Water District in the wintertime for the purpose of storing our Owens River water in a reservoir because it is very difficult for us to store Metropolitan water. We have no sites. They have no sites. They expect the user or the purchaser to store the water, not them, and so we do it in that way. We store Owens River water by using Metropolitan water in the wintertime. So that is an indirect way of doing it.

CHAIRMAN PORTER: You save withdrawal in any event. Any questions from committee members? Thank you very much.

MR. BUTLER: Mr. Chairman, no discussion of this program in the system of the San Gabriel River would be complete without the next speaker, Mr. Carl Fossette who has a number of hats. To my knowledge he is manager of three different water associations and four different water districts all concerned in one way or another with this problem. He is a man of much experience and for that reason we would like to hear from him now on his phase of that problem.

MR. FOSSETTE: Mr. Butler and Chairman Porter, as your seventh witness today, not to mention those you heard yesterday, I can only say that unfailing patience and enduring perseverance must certainly be the qualification to be a legislator.

CHAIRMAN PORTER: That is the first time in 12 years anybody has recognized that to my knowledge, but I'm glad you brought it up.

MR. FOSSETTE: Well, I think it should be. This is real work that you have been doing today. Mr. Chairman, we have provided two maps for you to look at briefly. The one that looks like Joseph's coat of many colors on the far wall, as a matter of fact, both of them were prepared two years ago by one of our water engineers who has worked for so many years, Bill Farquhar. In these two maps there are probably $2,000 worth of engineering service in their preparation, and so far we haven't received a bill for the work that Bill has performed on these maps. I guess we never will. It is a donation to the cause. The one over there represents the water service areas and what we generally refer to as the Central and West Basin area. There are over 150 water companies and water distributors represented in that map to show you the complexity of the problem. This map with the large blotches of color I have brought along so that you won't get lost during the course of this final and I trust brief presentation to you. The pink area represents the West Basin generally speaking. It is largely situated landward of the Inglewood-Newport Fault which is a jagged heavy line and the pink area represents a territory comprising the West Basin Municipal Water District which is a member agency of the Metropolitan Water District. The yellow territory, of course, represents the City of Los Angeles. The small green area is the City of Compton represented by Warren Butler on the Metropolitan Board. The orange area is the City of Long Beach and then the blue area is that area comprising the Central Basin Municipal Water District.

The upper area which is white is a portion of the main San Gabriel Valley Basin extending clear to the mountains which are not shown on the map. The Whittier Narrows is just above the two pink

spreading grounds that have been referred to frequently during this hearing.

Now, before we proceed further, Mr. Chairman, I would like to file with Don Benedict, your consultant, some documents for his study and use. The first is the judgment in the West Basin Case for adjudication of water rights entered August 22, 1961 after 16 years through the able and unfailing work of Rex Goodcell as chairman of the Legal Settlement Committee of the West Basin Water Association.

The next is the report on ground water replenishment and basin management of November 1960 prepared and released by the Central and West Basin Water Replenishment District.

The next is the annual survey report of that district on ground water replenishment of 1961.

The next is the report on the control and reduction of ground water pumping in the Central Basin dated October 10, 1961, published by the Central Basin Water Association. And finally, I have a survey and report on the need for a supplemental water supply dated September 14, 1961, a report to the Upper San Gabriel Valley Municipal Water District which is the area in the upper right-hand corner of the map. It is a report to that district on the need for supplemental water.

CHAIRMAN PORTER: Thank you very much. Let me make this comment, these are, of course, very important, but also very extensive documents. It would probably obliterate the committee budget if I were to make my usual comments about their being made a part of the record, so instead we will accept them for the files to be kept permanently in the committee office.

MR. FOSSETTE: Whatever use you care to make of them, Mr. Chairman. I didn't furnish copies of the reports for the committee members because the reports are expensive, $6 to $10 apiece and most of the information you have heard are in them. That is a factual record.

Mr. Chairman and Members of the Committee, for the past 20 years, or more, those responsible for the security of the public water supply in Los Angeles and Orange Counties, have sought to preserve, protect, replenish and manage the ground water resources for the use and future benefit of overlying cities and communities.

Our ground water basins have been damaged in past years, by over-pumping to meet the rising water needs of a growing population. We have lowered our water levels, in some areas lower than 100 feet below sea level. An extensive invasion of sea water has occurred in the fresh water supply of our coastal basins.

In looking back at what has happened to us, it is hard to see how it could have been otherwise. Our immense property values of today were originally based on our local water supply, obtained by over-drawing our basins. Now property bears its share of the burden of repairing the damage we did yesterday.

Our people have not always believed in the need for corrective measures, but they do now. For the past 10 years conservation projects have received wider acceptance. The Zone I program of water spreading in Central Basin by the Flood Control District has had unfailing public support since 1954. The same is true of the Zone II program in West Basin for construction of barriers to stop sea water intrusion, and for the reclaiming of waste water.

In November, 1959, the people in both Central and West Basins demonstrated by 4 to 1 majority vote their determination to restore and protect their ground water resources through formation of the first replenishment district under the Act of 1955. More than 1500 volunteers gathered over 150,000 signatures on a petition to place the replenishment district measure on the ballot for a special election.

The sponsors of the water replenishment district said it would do three things (in cooperation with other agencies):

1. Repel sea water intrusion,
2. Recharge the ground water basins, and
3. Reduce the pumping therein to safe limits.

Now that the District is formed, the sponsors, and the District Board have responsibility for carrying out the program, and I may say the sponsors are the pumpers in both basins, and this is being done. The program is not new to us; we started on it 15 years ago. We know that if we could have taken the Colorado River allowed to pass the idle pumps of the Metropolitan Water District in prior years, we would not now have a million acre-feet or more of vacant storage in Central Basin, and almost 3/4 million acre-feet of vacant storage in the main San Gabriel Valley Basin. But first we had to obtain the right to receive Colorado River water and then find a way to pay for it.

The protection, restoration, replenishment and managed use of a common ground water supply cannot be accomplished without some form of political endorsement, usually by public election, or by the Legislature to enact new laws, or to amend old ones, or by boards of

supervisors to approve plans and levy taxes, or by city councils, chambers of commerce and boards of local water districts expressing support.

The program thus far advanced in these two counties has required all such forms of political approval, plus court action.

Since 1947, there have been 12 public elections within the area of the replenishment district. All but one, the very first, were carried by overwhelming majority vote. All had to be held before starting a water replenishment district. In the Main San Gabriel Valley above Whittier Narrows, 2 such elections have been successfully held, and others must follow. Within the past 10 years, we recall at least 25 favorable actions of the Board of Supervisors of Los Angeles County regarding water conservation, and uncounted numbers of endorsing resolutions have been solicited, and received, from city councils, chambers of commerce and other public and civic bodies.

Political approval of basin management means higher taxes and increased water charges. For this reason, such approval is usually denied unless the need is great. Such was the case 14 years ago, in the first West Basin election to join the Metropolitan Water District. Inland cities, at that time, felt safe from sea water intrusion and they voted down the proposal.

The solution of ground water problems would be easier if all areas were short of water at the same time. But it does not happen that way. Communities farthest from the source of supply are the first to be hurt, and they are the first to seek a solution. Those closest to the source oppose a solution because of the expense involved, and delay results.

Many of our basins are inter-connected along one or more stream systems. For example, the San Gabriel River serves 3 principal basins along its course. Because of excessive pumping, the supply in each basin varies in relation to its nearness to the source. The water originates as rainfall in the San Gabriel Mountains. The flow from the canyons replenishes the Main San Gabriel Basin near the foothills, and anything that is left flows through Whittier Narrows to replenish Central Basin. The surplus, if any, from Central Basin finds its way by underflow across the Inglewood fault, into the West Basin to supply the coastal communities. Because they are farthest from the source, the West Basin people were in serious trouble as early as 1942.

A lawsuit was filed in 1945 to adjudicate West Basin water rights and curtail pumping. The coastal fringe of the Basin formed a district and joined the Metropolitan Water District in 1948. Inland cities of the Basin rejected the move but were soon forced to follow suit as the shortage moved upstream. Gardena, Inglewood, Hawthorne, and Dominguez joined the West Basin and were annexed to Metropolitan.

By 1952, the shortage had moved upstream to Central Basin where a district was formed to be annexed to Metropolitan in 1954. Now the shortage has moved upstream past the Whittier Narrows to the Main San Gabriel Valley Basin where water levels are the lowest of record. Here the pattern is being repeated at the very source of supply.

In 1960, a district was formed in the main basin to obtain new water involving higher taxes and increased rates. Here

again, those closest to the source, or believing they were more favorably situated, opposed a basin-wide solution. Four (4) of the Valley cities formed a small district to avoid being included in the larger one. Since then, 2 more dry years have passed, and the original proposal seems more attractive to those who once opposed it. The larger district has caused an engineering survey and report to be made on the need for supplemental water in its area. The report says there is a need for new water now, and the need will grow to 131,000 acre-feet per year 30 years hence, because there will then be 3 times as many people in the district. The engineers are now at work on a second report pointing out the best source of supplemental water for the district.

This bit of local water history is recited as an example of the piecemeal approach to basin management imposed upon us because of political necessity. Similar problems have been encountered along the Santa Ana River.

We have long been aware that basin management alone is not enough. Where basins are inter-connected, management should apply to the entire stream system, to achieve the greatest good for the greatest number. Within the Replenishment District, progress in this direction is being made. The down river people of the West Basin and the middle river people in Central Basin are united under the program. The participation of the upper river people in the Main San Gabriel Basin must await the arrival of supplemental water in that area and assurance of political feasibility at some future date. Good progress in that direction is being made. On September 26 of this year, an agreement on basic principles of settlement was

signed by negotiating committees, arising out of a law suit brought by the lower area against the upper area for a fair division of the waters of the San Gabriel at Whittier Narrows. This represents a milestone in water litigation. In the West Basin Case, 10 years were required to accomplish as much.

The Replenishment District is now in its second year of operation, and its program is widely accepted. The $3.19 per acre-foot pumping assessment for the first year raised $1,105,921.94; of that amount all but $432.98 remains unpaid by the pumpers. (Two (2) dairies owe $1.06, and 2 bankrupt farmers owe the balance.) This year the pumping assessment is $5.75 for $1,800,000. Of the amount collected, all must be expended to buy water for spreading, or for injection to repel sea water intrusion. The District will buy all the Colorado River water than can be made available for replenishment and it has contracted to buy reclaimed water from the Reclamation Plant now being constructed at Whittier Narrows. As an example of complete cooperation without duplication, the water will be reclaimed by the County Sanitation Districts, it will be received and spread by the Flood Control District below the Narrows and the rate charged to the Replenishment District will be sufficient to repay the County the $1,700,000 it advanced to build the plant.

There remains for the Replenishment District the problem of reducing pumping to safe limits. The sponsors of the District realized, before it was formed, that overdraft on the basins could not be corrected without adjudicating water rights, because, there is not now, and there will not be, enough Colorado River water <u>available for replenishment</u> to offset the overdraft, and it is not possible to

spread enough water in the Montebello Forebay to offset the overdraft because the outflow of such water from the Forebay to depleted areas is too slow.

The West Basin, comprising about a third of the area of the Replenishment District, has operated for several years under court approved curtailment of pumping. Only 30% of the water used in West Basin is supplied by wells, 70% is furnished by the Metropolitan Water District, and this has helped stabilize water levels. Pumping in Central Basin is unrestricted and 83% of the water used there is produced from wells, while only 17% is furnished by Metropolitan.

There are 37 service connections to the Metropolitan Water District system in Central Basin, having a total capacity of 530 second-feet. They are seldom used because producers are not willing to reduce pumping in an area where no legal action has been taken to adjudicate water rights. They know, that under the decision in the Raymond Basin Case, the more water a producer pumps the greater his right becomes, and that if he reduces his pumping, his water right could be proportionately impaired.

Last February, the Central Basin Water Association formally requested the Board of the Replenishment District to bring an action for adjudication of water rights. Some changes in the Replenishment Act were necessary and that has been accomplished, thanks to your committee. Last month the Association submitted a proposal for a voluntary reduction in pumping. The plan will reduce pumping by 25% or about 70,000 acre-feet a year. The proposal was explained at a meeting of over 90 producers on October 31, their approval was almost unanimous. The attorneys are instructed to file the action before the end of this year.

It has been the practice in past years to use the ground water as the basic source of supply and to only use the more expensive imported supply to meet peak demands. The intrusion of sea water, lowered water levels, and court approved curtailment of pumping have forced a reversal of the practice in West Basin. The ground water entitlement in that area is now carefully conserved to meet unforeseen demands. This should be done in Central Basin and elsewhere. Under a planned replenishment program, it is just as effective to reduce withdrawals as it is to add new water to a basin.

Mr. Chairman, and Members of the Committee, we feel that your hearing today is being held in one of only 3 or 4 areas of the State where a planned program of ground water replenishment is truly effective; and we believe this is perhaps the only area in the State where there is a clear and present promise of managed use for an entire underground stream system involving interconnected basins.

This is the only area we know of in the State where a barrier is in place to halt invading sea water, with financing and plans in hand, or in sight, to complete needed projects. And we know of no other area where adjoining counties have under consideration a joint endeavor for construction of a barrier in a common effort to stop sea water intrusion. We are referring to the Alamitos Gap on the County line at the mouth of the San Gabriel River.

This is the area that originated the language in Senate Bill 1440, and supported its adoption as the Porter-Dolwig ground water basin protection law. This law, as you know, declares that the people have a primary interest in correcting the impaired use of, and in preventing irreparable damage to, the ground water basins,

caused by critical conditions of overdraft, depletion, sea water intrusion, or degraded water quality.

This is an area where sensible men have joined together in countless meetings, seeking common solutions for their mutual problems, realizing their dependence on foreign water brought here over hundreds of miles of desert wasteland, and realizing also that the cold war is getting warmer, that if the Kremlin can throw things at the moon and hit it, it can also hit the Colorado River Basin, or the Mono Basin, or the pipe lines reaching from there to here.

Our people know, without pressing the panic button, that if our basins are brimming with stored water, we can last for 5 years. We think it only wise and prudent to make it so.

I thank you.

CHAIRMAN PORTER: Thank you very much, Carl, for an outstanding paper. It was a beautiful balance of historical background and statistical and factual material in the present. Are there any questions?

MR. BUTLER: May I add my thanks, Mr. Chairman, and may I also at this time thank the committee for giving us of its time to listen attentively to this very complex subject. We hope we have provided for you material which will be useful in your legislative work.

CHAIRMAN PORTER: Thank you very much, Mr. Butler. May I commend all of those who appeared today, and the committee is aware of the importance of this entire ground water problem. That is why we are meeting here, and as Carl Fossette said in his paper very succinctly, we are meeting here in one of only three or four places in the State where we can see successful going basin management programs.

I want to say this to all of the people here that the fact that many of the committee members had to leave to be on their way is unfortunate, but don't let it disturb you. Two of them I know of in particular have 9:00 o'clock committee meetings possibly just as important as this one in Sacramento and so they have a long way to either drive or to try to get there by planes. Other members as I look around have appointments that have made them leave and catch airplanes or be elsewhere. You may be reassured, however, that Mr. Robie of the committee staff will compile a complete set of all the papers presented and they will study their homework so they will be caught up on the presentations which have been made here today. Now, Mr. Benedict has a question I believe that he wants to ask.

MR. BENEDICT: Well, either Mr. Fossette or the Department of Water Resources. It appeared to me from the testimony today that it was not clearly entered into the record the relationship between the recharge operations at the Whittier Narrows and the ground water problems in the Central and the West Basins. In other words, you have a geologic situation there. Mr. Fossette touched upon it when he mentioned the Montibello Forebay, but I don't believe the record has at any time indicated why all of this activity in the Whittier Narrows area and this might be helpful for the committee to have in the record.

MR. FOSSETTE: Do you want me to try to answer that, Don?

MR. BENEDICT: Yes.

MR. FOSSETTE: Max, if I get into trouble, will you help me? Max is our engineer for the replenishment district. This generally speaking down to Firestone is the free water area where you can

sink water because there is no clay. The underground aquifers surface here primarily along the Rio Hondo and along the San Gabriel. When you are below firestone -- well, it is here, I guess, an overlying clay cap is present which means that any water that occurs here, you can't do anything with it except send it to the ocean. So we have this area where we can percolate water and we are percolating water. Now, the underflow or passage of this water to the depleted areas here where it is 100 feet below sea level is so slow that even if we could buy enough Colorado River, which we can't because it is not available, to put in here to meet our overdraft, it would not flow fast enough through this area to take care of the needs here because the forebay would fill up and overflow and it would waste to the ocean. For that reason we have to curtail pumping. Now, we have Metropolitan pipelines with ample supply of water stretching across Imperial, the middle feeder down this way, the West Coast feeder here, the West Basin lateral here, the Palos Verdes feeder with about 400 second-feet of capacity with installed meter boxes already hooked up to cities and water companies in this whole area. The same is largely true in this area except for Whittier and this general forebay area and except for Lakewood, and that will be taken care of when the Long Beach feeder to supply the barrier is finally constructed,but we have over in this area already installed over 500 second-feet of surface capacity, but as I tried to explain, that is not being used because there is no adjudication here. It is being used here. We only pump a small amount of water in this area now. We stabilize levels and we are protecting the underground supply against unforeseen needs and to meet peak demand.

With the filing of an action here and the firming of water rights and through the operation of an exchange pool to take care of those people who are not now connected to Metropolitan, the pumping will be reduced first by 70,000 acre-feet a year and more during later years if it proves necessary. By that means we will bring this basin, this part of it, into balance and we will meet our overdraft, and in the future will make gains on it. Does that answer the question?

MR. BENEDICT: I think it does. Briefly the point is that by putting water in at the Whittier Narrows you there are putting water into the sands and gravels at the surface which travel underground to the south and to the west and constitute the aquifers that these areas in the West and Central Basins are pumping from and these are the depleted aquifers and this is the reason for the concentrated attention at the Whittier Narrows in the Montibello Forebay area. I just wanted to point this out. It has these other problems that you were talking about, but this is the reason for the attention at Whittier Narrows rather than someplace else.

MR. FOSSETTE: Yes. If we put 50,000 acre-feet of water in the completed barrier here, that will serve as a replenishment here and the same will be true to a much lesser extent in the Alamitos Gap when it is constructed. I can think of nothing else to add, Don.

MR. BENEDICT: Thank you.

CHAIRMAN PORTER: Very good. Any questions by members of the committee? Again let me thank all of you have helped to make this meeting possible, particularly our hosts in the nearby portions of Los Angeles County, the Metropolitan Water District, and of course,

the water agency representatives in Orange County. Senator Murdy returned briefly after lunch, but then was called away and he offered his regrets that he could not be with us throughout the afternoon.

I'm delighted, of course, that Senator Slattery could be with us. For all of the hard work you have done in the preparation of these papers, you will be repaid. I heard several people on the committee make the comment and they were from some distance from here, that they didn't know that such work was going on and in some cases that it was going on on such a large scale, so it's been an extremely profitable inspection trip yesterday and series of hearing papers today in the testimony we have heard on the technical information of the programs that are going on in these two counties. Anything else for the good of the order?

SENATOR SLATTERY: I would like to take this opportunity to thank you and your committee for giving me the privilege of listening to this very interesting discussion for the past two days and I, too, had no idea of the amount of work certainly that was going on in this area towards conserving and recharging these water basins, and I certainly appreciate the opportunity and I hope to be able to report some of the things that were said here to the members of the Senate Interim Water Committee.

CHAIRMAN PORTER: Good. Thank you, Senator. The next time we will try to bring your whole committee. They have always treated me probably as well as I should be treated because that is about the way I have treated them I suppose, but we will get back to all the good aspects of the Joint Water Committee with such a good emissary.

SENATOR SLATTERY: As you know, we have a slightly different

orientation than does your committee.

CHAIRMAN PORTER: Well, that is a nice word for it and you are right, and they call me a politician. Is Howard Crooke still here? Was I supposed to call on you before we adjourn or did you want to come up and speak to the committee members about future plans after we adjourn?

MR. CROOKE: That would be fine probably. Go ahead and adjourn and then I'll come up.

CHAIRMAN PORTER: Very good. With the understanding that the committee members will remain briefly for a minute why this meeting is now adjourned. Thank you.

(Thereupon the meeting was adjourned.)

REPORTER'S CERTIFICATE

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This is to certify that I, Alice Book, a Certified Shorthand Reporter, was present at the time and place the foregoing proceedings were had and taken before the Assembly Interim Committee on Water, held in the Disneyland Hotel, Anaheim, California, on November 29, 1961, and that as such reporter I did take down said proceedings in shorthand writing, and that thereafter I caused the shorthand writing to be transcribed into longhand typewriting, and the foregoing pages beginning at the top of page 1 to and including line 28 on page 140 hereof, constitute a true, complete, accurate and correct transcription of the aforementioned shorthand writing.

Dated this 17th day of December, 1961.

Alice Book

Certified Shorthand Reporter